BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAI'I

In the Matter of	)	
	)	
PUBLIC UTILITIES COMMISSION	)	Docket No. 2008-0273
	)	
Instituting a Proceeding to Investigate The Implementation of Feed-in Tariffs.	)	
	)	

FILED

2010 MAR 23 P 4:12

PUBLIC UTILITIES COMMISSION

THE SOLAR ALLIANCE'S AND HAWAII SOLAR ENERGY ASSOCIATION'S COMMENTS ON PROPOSED FEED-IN TARIFF RELIABILITY STANDARDS

AND

CERTIFICATE OF SERVICE

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THE SOLAR ALLIANCE'S AND HAWAII SOLAR ENERGY ASSOCIATION'S COMMENTS ON PROPOSED FEED-IN TARIFF RELIABILITY STANDARDS

Pursuant to this Commission's Decision and Order filed September 25, 2009 ("D&O") and Order Setting Schedule filed October 29, 2009, as modified by the Order Granting Extension Request filed March 11, 2010, the Solar Alliance and Hawai'i Solar Energy Association (together, "SA/HSEA") hereby respectfully submit the following comments on the various documents regarding Feed-in Tariff ("FIT") "reliability standards" submitted by Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Ltd. (collectively, the "HECO Companies"). These include: *the Report on Reliability Standards filed on February 8,* 2010; Clarification to Reliability Standards Report filed on February 9, 2010; Response to Commission Letter of February 19, 2010 filed on February 26, 2010; Responses to Information Requests ("IRs") filed on March 1, 2010; and Responses to Informal Supplemental IRs received on various dates beginning on March 11, 2010.

I. INTRODUCTION

In its September 25, 2009 D&O, the Commission cast a bold vision for the Hawai'i FIT program. This included extending the program to system sizes (Tier 3), beyond which the HECO Companies proposed based on the express "desire to accelerate the adoption of renewable energy and reduce the State's dependence on imported fossil fuel." Id. at 43. The HECO Companies could have embraced the Commission's D&O as a charge to aspire further to meet Hawai'i's ambitious clean energy mandates. Instead, they took it as free license to impose whatever limits they desire on renewable distributed generation ("DG"). In so doing, the HECO Companies emphasized, yet again, (1) the inherent conflict in their control over access to the grid, and (2) the need for an independent entity to move Hawai'i rapidly, decisively, and irreversibly forward on its clean energy goals.

As discussed below, the HECO Companies in all their voluminous filings do not provide any reliability standards, but instead simply argue for blanket limits on renewable DG. In so doing, they contradict their long-standing positions in the October 2008 Energy Agreement ("Energy Agreement"), and throughout this FIT docket, the PV Host docket, No. 2009-0098, and the Net Energy Metering ("NEM") docket, No. 2006-0084. Moreover, they highlight the failures in their entire mindset, including: their counterproductive premise that renewable energy is "the problem," rather than a beneficial part of the solution to Hawai'i's energy and economic development challenges; and their contradictory and discriminatory application of their proposed limits on DG, but not on larger, transmission-level projects.

In the end, the HECO Companies fail to meet their burden of justifying their proposed blanket limits. On the few issues that they address with any evidence or analysis, such as the system frequency balancing and curtailment issues, the HECO Companies go out of their way to inflate or (in the case of curtailment) create the problem, rather than focusing on solutions. The reality is that their proposed limits will severely harm Hawai'i's renewable energy industry and the entire state by prolonging Hawai'i's dependence on imported fossil fuels. Accordingly, SA/HSEA respectfully request the Commission, regardless of what it decides on the HECO Companies' Working Group proposal, to reject the HECO Companies' proposed limits on renewable DG.

II. BACKGROUND

For the Commission's reference, SA/HSEA summarize the relevant background and procedure in relation to the issue of FIT reliability standards.

Commission's Direction to Develop FIT Reliability Standards

In its D&O, the Commission instructed the HECO Companies "to develop reliability standards for each company, which should define most circumstances in which FIT projects can or cannot be incorporated on each island." Id. at 50. These standards "should complement existing standards, including those in the HECO Companies' tariff Rule 14." Id. Moreover, the HECO Companies were to "incorporate the other parties to this docket into the process of crafting these standards." Id.

The Commission "encourage[d] the parties to initially focus on resolving the issues in Tiers 1 and 2, to facilitate the immediate implementation of FITs in those tiers."

Id. at 46. The Commission established Tiers 1 and 2 "based on the HECO Companies' arguments and evidence that projects up to those sizes could be rapidly evaluated and integrated into the HECO Companies' systems at relatively low cost and with fewer reliability concerns." Id. at 45. See also id. at 68 ("expect[ing] the parties . . . to have a FIT in place for those tiers as expeditiously as possible").

On October 29, 2009, the Commission issued its Order Setting Schedule outlining an expeditious timeline for further proceedings, including various dates for the development of reliability standards. These included: "Technical Session on Reliability Standards" on November 20, 2009; "Technical Session on Reliability Standards (if desired)" in January 2010; "Filing of Reliability Standards" on February 4, 2010; "Parties [IRs] on Reliability Standards and Queuing and Interconnection Procedures on February 11, 2010; "Parties Responses to [IRs]" on February 18, 2010, and "Parties Comments on Reliability Standards" on February 25, 2010.

Technical Sessions

Pursuant to the schedule, the HECO Companies held a meeting on reliability standards on November 20, 2009, in which they presented a powerpoint reviewing general concepts. Duda Dec. ¶ 16, attached hereto. The presentation referred to "cap" and "non-cap" options, and also used the term "target." Id. The HECO Companies provided no specific figures or analysis, or other concrete proposals. Id. In response to concerns expressed by intervenors, the HECO Companies insisted they were not redrawing the FIT system caps the Commission established in its D&O. Id.

After intervenor parties inquired about a follow-up session, the HECO Companies held a second meeting on reliability standards on January 26, 2010. Id. ¶ 17. The meeting involved another powerpoint presentation, which reviewed general information on the levels of DG penetration of the HECO Companies' grids. Id. Again, the presentation alternated between the terms "cap" and "target," and the parties received conflicting messages, including the assurance that the Companies were not proposing actual "caps." Id.

Rule 14H Proposal

Meanwhile, on January 7 and 8, 2010, the HECO Companies filed applications to amend their tariff Rule 14 standards. In addition to the long-awaited and much needed increase of the DG circuit penetration limits for purposes of requiring interconnection studies from 10 to 15 percent of peak load, as the HECO Companies promised in the Energy Agreement, see id. § 19, the Rule 14H applications included numerous new restrictions on renewable DG. These included references to "system-wide" limits as an additional trigger for interconnection studies, but the applications did not specify any such limits. Various parties to the FIT docket filed protests to the applications, and on January 27, 2010 the Commission issued an order suspending the filings and initiating a new docket, No. 2010-0015, in which several FIT docket requested and were granted intervention.

FIT Reliability Standards Proposal

On February 3, 2010, the HECO Companies filed a request to extend the deadlines related to reliability standards by several days. The request stated that the

HECO Companies have been "refining the final Standards," "[b]ased in part upon comments received during the workshops." Id. at 1. On February 8, 2010, the HECO Companies filed their "Proposed FIT Reliability Standards," in which they proposed to: limit total DG penetration for the O'ahu grid to 60 MW (five percent of peak load); "[d]efer additional variable DG interconnection requests, including standard interconnection agreement and NEM requests, until appropriate mitigation measures are identified and employed" for the Maui and Hawai'i grids; and "[d]efer additional DG interconnection" on the Lana'i and Moloka'i grids. HECO Companies' Exh. 1 at 30. The HECO Companies also "support[ed] convening a Reliability Standards Working Group." Id. at 4. On February 9, 2010, the HECO Companies filed a letter correcting some figures in several tables in their February 8 filing and "clarify[ing] that any proposals to temporarily defer interconnection of additional distribution level resources until additional study can be completed, are fully understood to be subject to the further action and direction of the Commission . . . ." Id. at 1.

Revised Proposal

On February 19, 2010, the Commission sent the HECO Companies a letter directing them "to further elaborate on their deferment proposals, including, how and when will appropriate mitigation measures be identified and employed, and on their proposal to 'conven[e] a Reliability Standards Working Group.'" Id. at 2. On February 26, 2010, the HECO Companies filed a response to the Commission's February 19 letter. The HECO Companies "continue[d] to stand by [their] findings" regarding constraints on intermittent renewables on Maui, Hawai'i, and Lana'i. Id. at 2. They also proposed the Working Group "to quickly examine the[ir] concerns, and if confirmed, to identify technical and policy solutions . . . ." Id. In addition, the HECO Companies stated:

- HELCO and MECO "will continue to accept applications up to the existing program levels set at 3% of each island's system peak load," but added that, although they previously agreed to, and the Commission approved, an increase of the NEM program caps to 4%, "in light of the issues raised on the MECO and HELCO systems we propose that the Working Group evaluate this." Id. at 3.

- the FIT program would proceed on O'ahu, but "the timing of implementing FIT at MECO and HELCO should be subject to review by the proposed Working Group." Id.

- the HECO Companies "will propose . . . the PV Host program for Maui and the Big Island be deferred indefinitely," but "HECO still desires to implement the PV Host program on O'ahu, and will continue with the application review process." Id. at 4.

- the HECO Companies are continuing an "aggressive push" and "active" negotiations of power purchase agreements ("PPAs") on a list of specific projects for HELCO and MECO, but other proposals for HELCO and MECO are "subject to increased scrutiny on proposal completeness and project viability, [and] no determinations on performance requirements, curtailment or contracting priority will be made in advance of the establishment of final reliability standards." Id.

The parties filed IRs on February 16, 2010. On February 23, 2010, the HECO Companies filed a request for extension of several deadlines related to the reliability standards. The parties filed responses to IRs on March 1, 2010. The parties subsequently exchanged, on an informal basis, supplemental IRs and responses. On March 15, 2010, the parties submitted comments specifically on the HECO Companies' Working Group proposal.

III. THE HECO COMPANIES HAVE NOT PROVIDED RELIABILITY STANDARDS, BUT AN ARGUMENT FOR LIMITING ACCESS OF DISTRIBUTED RENEWABLE ENERGY TO THE GRID

A. Basic Concepts Must Be Established At The Outset.

As SA/HSEA discussed in their previous comments on the HECO Companies' Working Group proposal, key definitions and distinctions must be established on several basic concepts in order to minimize confusion and enable productive discussion. These include:

(1) Reliability Standards, which under the industry definition are a comprehensive set of technical standards governing grid operation in clear, objective, and transparent terms, such as, for example, the North American Electric Reliability Corporation or "NERC" standards governing mainland grids. See <http://www.nerc.com/page.php?cid=2|20>

(2) A different, brand new concept imposed by the HECO Companies, which is not Reliability Standards, but rather an argument for blanket caps or limits on distributed renewable energy penetration. For lack of a better term, SA/HSEA will refer to this concept as "HECO Caps or Limits."

(3) "FIT reliability standards," which are what the Commission called for in its D&O to "complement existing standards, including those in the HECO Companies' tariff Rule 14" in order to "define most circumstances in which FIT projects can or cannot be incorporated on each island." Id. at 50 (emphasis added).

Moreover, because the issues of "reliability," related to reliable grid operation, and "curtailment," related to displacement of other renewable energy generation, are conceptually distinct, yet misleadingly lumped together in the HECO Companies' arguments, SA/HSEA recommend the separate term "FIT curtailment standards" to refer to the specific issue of curtailment, see infra Part V.C. for further discussion.

B. The HECO Companies Do Not Provide Any Standards.

First, SA/HSEA reiterate that the HECO Companies -- and the people of Hawai'i -- need true Reliability Standards. The HECO Companies, instead, simply argue why more distributed renewable energy should not enter the grid, citing an inscrutable set of "principles" that grant the HECO Companies total discretion to equate "reliability" with whatever limits they feel like imposing on distributed renewables, see HECO Companies' Exh. 1 at 9 & Figure 1. The HECO Companies explain that they based their "principles" on "[s]ound electrical planning, operating practices, and engineering guidelines derived from operating experience and engineering studies," Id. at 9 -- which of course adds no clarity whatsoever. Their responses to repeated information requests are equally elusive.[1] In short, the HECO Companies' "standards" simply adopt a "Humpty-Dumptian" rule of reliability as "what [the HECO Companies] choose it to mean – neither more nor less."

Without true Reliability Standards, renewable energy development in Hawai'i will continually be subject to such arbitrary and haphazard limits based on whatever "standards" the HECO Companies chose to impose at any given time. Besides contravening fundamental tenets of regulatory policy, as a practical matter, this will only maximize uncertainty for renewable energy developers, stifle the Hawai'i renewable energy market, and hinder Hawai'i's goal of moving "decisively and

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[1] See, e.g., Response to BP-HECO-IR-20 (declining to provide any documents on formal written operating procedures, but citing "an extensive and diverse range of sources, including planning criteria, operation criteria and practices, parameter settings on the real-time operations systems (SCADA/EMS and AGC), recorded system frequency performance, etc. [which are] not from an easily producible published set of procedures").

irreversibly away from imported fossil fuel," as the HECO Companies promised in the October 2008 Energy Agreement ("Energy Agreement"). Id. at 1.

SA/HSEA and other parties have proposed that the Commission require the HECO Companies to establish Reliability Standards. Such comprehensive standards, however, will necessarily take some time to develop and will require additional proceedings, potentially in an independently dedicated docket. In the meantime, Hawai'i's nascent clean energy movement cannot afford to stop and wait, but must continue to move forward based on the understanding, shared by the HECO Companies, that "the very future of our land, our economy and our quality of life is at risk." Id. at 1.

Given these pressing needs, the Commission and the parties, presumably, prefer that the FIT program proceed in the meantime. Accordingly, interim standards are needed to facilitate the immediate implementation of the FIT program, which should "complement existing standards," including the HECO Companies' tariff Rule 14, yet "provide greater predictability with respect to reliability issues for developers." D&O at 50. SA/HSEA believe these are the FIT reliability/curtailment standards the Commission intended.

Unlike the HECO Companies, SA/HSEA never interpreted the interim FIT reliability standards as calling for a grid-wide HECO Cap or Limit, by which the HECO Companies could essentially redraw the FIT program caps the Commission established and impose blanket limits on all distributed renewables. Such HECO Caps or Limits are a brand new concept the HECO Companies imposed for the first time in their

February 8, 2010 filing, after continually refusing throughout this proceeding to provide the parties and Commission any specific information on such potential limits. See D&O at 49 (documenting that the "HECO Companies declined at the panel hearing and in their submissions to define how much renewable energy each island could incorporate").

SA/HSEA, as the actual participants in the market and the FIT program for whom "transparency and predictability" is a real need and not an abstract concept, always understood "FIT standards" not as HECO Caps or Limits, but rather as a working list of technical requirements or guidelines, set forth in the most straightforward terms as possible, that would serve, as the Commission described, to "provide greater predictability" and "define most circumstances in which FIT projects can or cannot be incorporated on each island." Id. at 50. A prime example of such a "FIT standard" would be the requirement, already being implemented by some of the HECO Companies (at the solar industry's urging), that photovoltaic ("PV") systems set their underfrequency trip settings at a frequency lower than the load shed points for the grid, which as the HECO Companies explain, addresses the concern of mass tripping of PV systems in response to the loss of one of the larger resources on the system. HECO Companies' Exh. 1 at 34; see also Duda Dec. ¶¶ 19-21. In sum, interim FIT standards for reliability or curtailment should provide practical, concrete solutions specifically tailored for actual problems, not simply a blanket Limit on all DG as the HECO Companies seek to impose.

IV. THE HECO COMPANIES' PROPOSED LIMITS CONTRADICT THEIR LONG-STANDING, CONSISTENT POSITIONS

In addition to being internally inconsistent, the HECO Companies newly proposed Limits contradict their repeated and consistent representations in the Energy Agreement and in this and other dockets, stretching back for more than one-and-a-half years. The HECO Companies have never explained or justified these contradictions, but simply would have the parties and the Commission forget that the last 17 months since the Energy Agreement ever occurred.

The Energy Agreement

As the Commission is well aware, the HECO Companies, along with the state Governor, Consumer Advocate, and Department of Business, Economic Development & Tourism publicly committed in writing to numerous important clean energy advancements in the Energy Agreement. This included:

- The FIT system "designed to dramatically accelerate the addition of renewable energy from new sources," October 2008 Press Release at 2, with the benefit of "predictability and certainty with respect to the future prices to be paid for renewable energy and how much of such energy the utility will acquire," Energy Agreement at 16. The Energy Agreement contemplated the adoption of the FIT program by July 2009 and made no mention of reliability standards in its list of key program factors. Id. at 17.

- Recognition that DG "can help replace central station generation and improve local grid operations and reliability" and a commitment "[t]o support and accelerate the adoption of" DG by, inter alia, "improving the process and procedure for interconnecting non-utility DG . . . to make it faster, efficient, and more transparent." Id. at 27.

- "[A]greement that there should be no system-wide caps on [NEM] on any of the Hawaiian Electric utilities." Id. at 28. Instead, "[DG] interconnection will be limited on a per-circuit basis . . . limited to no more than 15% of peak circuit demand for all distribution level circuits of 12kV or lower." Id. The Energy Agreement further provided an expedited review within 60 days for interconnection requests "particularly for PV" approaching the 15% limit, "to determine whether the limit can be increased." Id.[2]

It bears noting that the Energy Agreement included in Appendix "A" projected renewable energy projects for each of the HECO Companies that identified the same projects that the HECO Companies now cite to support their argument that MECO and HELCO cannot accept further DG under FIT and NEM, see infra Part VI.B. In other words, nothing has changed since the HECO Companies entered into the Energy Agreement a year and a half ago, except that the HECO Companies are now trying to rescind their commitment to integrating distributed renewables.

The Instant FIT Docket

Throughout this docket, the HECO Companies supported projects up to the Tier 2 size limits, explaining that "[t]he initial target project sizes are based on utility system integration considerations." Joint Proposal on Feed-in Tariffs of the HECO Companies and the Consumer Advocate, filed on December 23, 2008 at 9. The HECO Companies also maintained that the initial target sizes "do not typically, by virtue of their operating characteristics and size relative to the utility system, require extensive and lengthy interconnection studies or the need for significant interconnection requirements." Id.

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[2] See also Hawaiian Electric Industries, Inc., 2008 Annual Report to Shareholders, at 42 (available at: http://phx.corporate-ir.net/External.File?item= UGFyZW50SUQ9MzMwNjk4fENoaWx kSUQ9MzEyNTY4fFR5cGU9MQ==&t=1) (declaring "the commitment to support a variety of initiatives" including: "implementing feed-in tariffs to encourage development of renewable energy" and "removing the system-wide caps on [NEM] (but limiting DG interconnections on a per-circuit basis to no more than 15% of peak circuit demand)."

The Commission relied on these representations by the HECO Companies in their written submissions and during the hearing in deciding:

> Based on the record in this proceeding, projects in the first and second size tiers should enjoy relatively uniform interconnection costs and should be less likely than larger projects to need Interconnection Requirements Study ("IRS") examinations. The commission elected to use these tier cutoffs based on the HECO Companies' arguments and evidence that projects up to those sizes could be rapidly evaluated and integrated into the HECO Companies' systems at relatively low cost and with fewer reliability concerns. If experience demonstrates that these size limits do not accurately reflect the sizes of projects needing an IRS or do not reflect where economics of scale are realized, the commission will consider adjusting them at the first periodic reexamination.

D&O at 45-46. The Commission also relied on the record the HECO Companies developed in: specifically recognizing that "the HELCO and MECO grids . . . are much smaller and have considerable renewable penetration"; noting the HECO Companies argument that increasing project size limit beyond Tiers 1 and 2 would "raise issues" particularly for those grids; and concluding, "[t]o address these concerns, the commission will limit additional wind generation projects (up to 100kW) on the HELCO and MECO systems for purposes of eligibility for the initial FIT" and preclude Tier 3 wind projects on Maui and Hawai'i. Id. at 43-45.

Thus, for over one year in the FIT docket, the HECO Companies never raised any issue of Tiers 1 and 2 projects jeopardizing the reliability of their grids, and the Commission specifically addressed the issues they did raise by limiting the size of wind projects for HELCO and MECO. At no time was a moratorium on the FIT program and other DG for HELCO and MECO an option.

PV Host Proposal, Docket No. 2009-0098

Moreover, the HECO Companies in their Application for Approval of a PV Host Pilot Program, filed on April 30, 2009, proposed to install, in each year of the two-year program: four to eight photovoltaic ("PV") systems on the HECO grid ranging in size from 500 kW to 1 MW for a target 4 MW of PV; and four to eight PV systems on both the HELCO and MECO grids ranging in size from 500 kW to 1 MW for a target of 2 MW of PV on each grid. Id. at 1, 15. This totals 4 MW of PV on each of the HELCO and MECO grids. The HECO Companies' efforts in developing and proposing these projects further belie their new claim that equivalent projects procured through the FIT would jeopardize the reliability of their grids.

NEM Stipulation and Order, Docket No. 2006-0084

Finally, in a December 3, 2008 stipulation in the NEM docket, No. 2006-0084, the HECO Companies and the Consumer Advocate agreed that HELCO and MECO would automatically increase the system cap for NEM from three to four percent of peak demand once NEM applications reached one of several thresholds. Id., Exh. 1 at 3, Exh. 2 at 3. On December 26, 2008, the Commission issued an Order approving the stipulation in part, ordering: "The increased NEM limits for HELCO and MECO, as proposed in the Stipulations, are approved." Id. at 13. Now, the HECO Companies seek to undo this Order and block the ordered increase,[3] in this improper forum of the FIT docket.[4]

[3] SA/HSEA note, however, that the day prior to this filing, MECO has submitted a letter notifying the Commission of its intent to move to four percent. This change appears to be in response to repeated questioning by one of HSEA's members about the

In sum, while the HECO Companies have failed to provide substantive proof and any "standards" to support their proposed Limits, the actual record before the Commission contains hundreds of pages of evidence supporting the deployment of the Tier 1 and 2 PV systems and some Tier 3 (up to 1 MW) systems, not to mention NEM projects currently limited to 100kW in size. The record also establishes that until their February 8, 2010 filing, the HECO Companies remained steadfast in their position that these projects would cause no risk to their grids. The HECO Companies' brand new proposed Caps and Limits are disingenuous and contrary to the pressing clean energy needs recognized in the Energy Agreement, and should be rejected.

V. THE HECO COMPANIES' PROPOSED LIMITS ARE ILL-CONCEIVED AND INVALID

A. The HECO Companies Did Not Collaborate With The Parties In Developing Their Proposal.

The Commission directed that "[t]he HECO Companies should incorporate the other parties to this docket into the process of crafting these [FIT reliability] standards." D&O at 50. SA/HSEA, initially, make clear for the record that they had no part in crafting the HECO proposal. See supra Part II. Almost all of the material in the HECO Companies' 125-page document was never seen by the parties prior to its filing, and the

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penetration percentage on the MECO system, which revealed that it was at or near 90 percent, notwithstanding that 75 percent was the cap-increase trigger ordered by the Commission. Duda Dec. ¶ 9.

[4] The NEM program has a history of being cabined by arbitrary limits. After the PUC initiated Docket No. 2006-0084 in April 2006, it took almost two years for the HECO Companies to propose raising the cap from 0.5 percent to one percent and increasing system size limits from 50 kW to 100 kW, then nine more months to agree to raise it again to the current three percent.

information that was disclosed was summarized in powerpoint presentations. While the HECO Companies raised concepts of "limits" or "targets" at the meetings, the parties objected to any redrawing of the FIT program limits and received no indication that the HECO Companies would seek blanket limits on renewable DG until their February 8 filing. None of the other parties suggested any such measure; rather, the HECO Companies developed and proposed it unilaterally.

B. The HECO Proposal Proceeds From A Fundamentally Counterproductive Premise.

While the lack of collaboration undoubtedly contributed to the HECO Companies' resulting product, the HECO Companies' entire mindset on "reliability standards" is the fundamental problem. As Dr. Fernando Alvarado, a recognized professor and expert on power system operations and former Chair of the IEEE-USA's Energy Policy Committee, explains, the HECO Companies' approach to reliability of imposing HECO Limits on renewable energy:

> is entirely the wrong solution to the problem. By failing to ask the question of "how do we integrate large amounts of renewables into the grid" and replacing it with the question of "how many renewables can our system take before we are forced to change the way we operate the system and charge for electricity" HECO is changing the game plan from one of innovation to one of preserving the status quo.

Exh. 2 to Alvarado Dec. at 1, attached hereto. Dr. Alvarado maintains that "it is possible for the State of Hawaii to go, not 70%, but actually 100% renewable in the not too distant future if it chose to do so," and that such a 100% percent renewable system could be "even more reliable than the current system." Id. HECO arguments, however, "take it as given that the future will look like the past: a central utility that charges fixed rates to 'ratepayers,' as if ratepayers were passive objects that are there just to consume the assigned fixed rates": "The lack of innovative thinking in the business is precisely what is at stake here." Id.[5]

The State of Hawai'i shares the same "vision" of a clean energy future as Dr. Alvarado. For that vision to succeed, we must move beyond rote "solutions" like the HECO Companies' proposed Limits, and the fundamentally outmoded and self-defeating mindset that underlies them.

C. The HECO Proposal Misleadingly Conflates Distinct Issues.

Moreover, the HECO Companies undermine efforts to reach solutions by mixing different issues together and seeking to impose one-size-fits-all Caps and Limits in response. As one prime example, the HECO Companies throughout their arguments conflate the issue of "reliability," related to reliable grid operation, and issue of "curtailment," related to displacement of other renewable energy generation. As SA/HSEA has emphasized, these issues differ on (1) the nature of the problem, if any, and (2) the menu of possible solutions. Indeed, the curtailment issue has nothing to do with "reliability" in any sense of the word. Yet, the HECO Companies' arguments lump the two issues together under the same term "reliability standard," which obfuscates the discussion and impedes the process of identifying effective solutions that are in the public interest. Again, SA/HSEA urge the Commission to put an early and

[5] Similarly, in their comments to the HECO Companies' "Working Group" proposal, SA/HSEA emphasized the need to "shift from studying the status quo to implementing solutions and gearing for change," and to stop "defining renewable DG as 'the problem'" and instead recognize its benefits and role in the solution. SA/HSEA Comments on Working Group Proposal at 9.

decisive end to this practice, and have instead proposed the separate terms "FIT reliability standard" and "FIT curtailment standard."

Even within the general category of "reliability," the HECO Companies identify distinct issues, such as (1) the concern of mass tripping of PV systems; and (2) the ability to ramp up conventional generation to meet potential variations in renewable generation. These issues are similarly distinct and cannot be addressed with monolithic methods.

Further, meaningful discussion and resolution of each issue must recognize other important distinctions based on: (1) island and/or grid characteristics; (2) types of renewable resources; and (3) renewable system sizes. For example, it makes no sense to block installation of PV systems that operate during the day because wind projects are being curtailed at night. Nor is it accurate or fair to attribute the variability of a single, centralized large wind project to multiple, distributed wind systems, or many distributed PV systems. The HECO Companies' arguments advance many such broad mischaracterizations.

The Commission, again, has already crafted a specifically tailored solution based on the record, in limiting wind generation projects on the HELCO and MECO systems to 100kW. See D&O at 44. To meet Hawai'i's critical clean energy needs, the Commission must continue to focus on real solutions to actual, proven problems and reject the HECO Companies' proposed blanket Limits.

D. <u>The HECO Companies' Proposed Limits Are Fatally Contradictory And Discriminatory</u>.

The HECO Companies ultimately negate their own arguments and proposed Caps and Limits by seeking to impose them on distributed generation, but not on larger, transmission-level projects. For example, even as they emphasize large wind systems as the "largest driver" of their reliability concerns, see, e.g., HECO Companies' Exh. 1 at 17, 36 (table), 37, the HECO Companies do not propose any Caps and Limits on transmission-level wind projects, and go even further to assume for purposes of their curtailment argument that several large, centralized wind projects will be built, see id. at 22, and that additional DG must accommodate these possible future projects. Such discrimination lacks any basis in technical or policy principles or even common sense. The HECO Companies' attempt to single out DG for their proposed Caps and Limits invalidates their proposal altogether.

VI. THE HECO COMPANIES HAVE NOT JUSTIFIED THEIR PROPOSED LIMITS.

The HECO Companies bear the burden of proving the need to impose their proposed Caps and Limits, particularly given the inconsistencies with the HECO Companies' long-standing positions and the state's expressed energy policies, and the serious consequences for Hawai'i's renewable energy industry, consumer choice, and the public interest. As explained below, the HECO Companies have not met this burden. The HECO Companies have proposed a "Working Group," the first stated purpose of which is to "evaluate" and "validate" the HECO Companies' claims. See HECO Companies' February 26, 2010 Response, Attach. 1 at 2. SA/HSEA have raised numerous concerns regarding the Working Group proposal in their Comments filed on March 15, 2010, but emphasize first and foremost that the proposed Working Group does not relieve the HECO Companies of their burden of proof and does not justify any interim Limits on distributed renewable energy, including the FIT and NEM programs.

Actual review of the HECO Companies' filings reveals them as lacking substance and instead containing scattershot and repetitive arguments against renewable DG based on generalized statements and speculation. In the end, the HECO Companies address only two "issues" with any degree of substantive evidence and analysis: (1) the reliability issue of system balancing and frequency control; and (2) the curtailment issue. On both issues, instead of taking a constructive, solution-oriented approach to their concerns, the HECO Companies go to extreme lengths to define distributed renewables as "the problem," which they then seek to magnify to the maximum disadvantage of these resources. In the end, such overreaching simply disproves their claims.

A. System Balancing And Frequency Regulation.

Under the heading of system balancing and frequency regulation HECO raises actually two points: (1) the potential for mass tripping of PV systems during under-frequency events caused, in the first instance, by a loss of conventional generation; and (2) the potential variability of renewable generation and the corresponding ability of the HECO Companies to ramp conventional generation to maintain frequency. SA/HSEA address these two issues in turn.

1. Mass tripping issue

The issue of the mass tripping of distributed PV systems is an example of the HECO Companies needlessly seeking to inflate a problem, even as they acknowledge a solution exists. Despite the importance the HECO Companies assign it in its recent filings, this issue, in fact, is not new, but arose several years ago from a single wind ramping event at the Kaheawa wind project that caused a number of inverter-based systems to trip off. See Duda Dec. ¶ 18. While the HECO Companies cited this single event as a concern against more of these systems entering the grid, it was the solar industry that suggested, then urged, the HECO Companies to adopt the solution of changing the PV inverter trip settings to a lower frequency, ideally below the load shed points for the grid. Id. ¶¶ 18-19. See, e.g., HECO Companies' Attach. 3 at 3 (load shed frequencies for the HELCO grid).[6] The HECO Companies eventually adopted this solution for the HELCO grid and, more recently, for the MECO grid, Duda Dec. ¶ 19, and now cite it as an example of a "change[] to enhance and facilitate accommodation of renewables." HECO Companies' Exh. 1 at 34. The important point here, of course, is not who deserves credit for this solution, but how a potential obstacle to renewable energy can be re-envisioned as a solution that advances the state's energy goals.

The HECO Companies, however, still attempt to use this issue as support for imposing their proposed Caps and Limits, noting that some existing systems on their grids still remain at 59.3 Hz. See, e.g., HECO Companies' Exh. 1 at 15. First, the trip

[6] Not only does this solution avoid the reliability concern of mass tripping, it improves reliability and provides a grid benefit by allowing PV systems to continue providing frequency support during frequency sags caused by the loss of other generators. Lenox Dec. ¶ 6.

settings on all new PV system inverters can be set or reset to 57 Hz, so there is no reason why new systems should contribute to this problem, assuming the HECO Companies would require it for the MECO and HECO grids as they have done for HELCO. Duda Dec. ¶ 20. Second, to the extent that older inverters that cannot be reset are interconnected to the grid, these earlier generation inverters have a limited lifespan of around 10 years and in many cases are reaching the end of their lives. Id. Upon replacement of these inverters the systems will conform to the current 57 Hz underfrequency trip setting, thus progressively reducing any vulnerabilities they may currently introduce. Id. Thus, the body of existing PV systems with inverter underfrequency trip settings at 59.3 Hz is a finite pool that can only decrease over time. Id. This means that any problem posed by existing systems will eventually resolve itself and, more to the point, cannot be used to justify blocking the interconnection of new PV systems going forward.

Although the HECO Companies initially sought to impose a Cap on the HECO grid of five percent of peak load on all DG, including FIT projects, thereby lowering the five percent program cap that the Commission established for the FIT program alone, they appear to have abandoned this proposal. Nonetheless, SA/HSEA point out that the only basis that the HECO Companies provided for such a Cap was the makeshift analysis by their consultant envisioning an instantaneous loss of 25 to 50 percent of 60 to 180 MW of distributed PV in addition to the 180 MW AES coal plant. See HECO Companies' Attach. 1 at 6-9. While the HECO Companies are deceptively vague on the issue, the only conceivable scenario in which such a "sudden" mass loss of distributed

PV could ever occur is not through environmental conditions, but through a mass under-frequency tripping event. See Lenox Dec. ¶¶ 4-6, attached hereto. Thus, if the HECO Companies required that all PV systems connecting to the HECO grid set their inverter trip settings at 57 Hz, they could avoid the problem from the outset. Yet, they still went through the trouble of constructing and analyzing their imaginary straw-person scenarios as support for imposing a HECO Cap and Limits on DG penetration.

In sum, the under-frequency trip issue highlights the HECO Companies' overall tendency to create problems for renewable DG, rather than solve them. See Exh. 2 at 2 (Dr. Alvarado) (crediting the HECO Companies' change of the under-frequency relay settings to accommodate more renewables as "a step in the right direction," but maintaining: "They just have not gone far enough"). This should cease: the requirement of new PV systems to set their under-frequency trip settings at 57 Hz should be adopted as a "FIT reliability standard" to facilitate FIT projects, and the issue should no longer be used to justify any HECO Caps.

2. Ramping issue

As for the issue of the HECO Companies' ability to ramp their conventional generation in response to potential variability of renewable generation, the HECO Companies' provide no evidence or analysis to substantiate their claim that this is a problem. Their filings do not allege, let alone prove, any grid outages caused by renewable energy generation. Similarly, the HECO Companies' official "Service Reliability Reports" for HELCO and MECO filed with the Commission documents tens of thousands of customer interruptions and interruption hours, from causes ranging from failure in equipment and operation, trees and branches, auto accidents, and deterioration, but does not attribute a single incident to renewable energy systems. See Exhs. 7 & 8, attached hereto. The only evidence and analysis the HECO Companies provide relate to the previous issue of potential mass tripping of renewable systems adding to an independently caused under-frequency event, already addressed above. The HECO Companies, in effect, attempt to hold renewable energy generators to stricter standards than the HECO Companies meet themselves.

The HECO Companies repeatedly identify variable wind generation as the source of their concerns and the "primary" or "largest driver for frequency error." See, e.g., HECO Companies' Exh. 1 at 17, 36 (table), 37; see also id. at 29 (noting problems from "certain wind plants"). As support, the HECO Companies showcase only specific episodes at single, large wind plants, see, e.g., HECO Companies' Attach. 3 at 14-15; Response to SA/HSEA-RS-IR-14 at 2 (responding to a request for documentation of grid reliability disruption from intermittent resources with a graph of a single wind ramp event). First, SA/HSEA understand that studies show that multiple, distributed wind projects decrease the overall variability of wind generation, but will defer to parties representing wind energy on this. More broadly, the HECO Companies fail to explain or justify how concern over wind generation supports blanket Caps and Limits on all DG, including solar.

The HECO Companies state that "[t]he typical capacity factors for PV resources of various sizes, variability due to environmental and weather patterns, and correlation between sites are not known." HECO Companies' Exh. 1 at 40. While the HECO

Companies may lack such data (which deficiency they then oddly attempt to use against solar energy and Hawai'i clean energy goals), the suggestion that such data does not exist is false. In fact, "a wealth of data has been and is being developed on each of these issues by the solar industry, academia, and the national laboratories, and much of it is publicly available in published reports and journals." Lenox Dec. ¶ 3.

Had the HECO Companies collaborated with SA/HSEA and other solar parties, they may have improved their analysis and proposal by confirming, among other facts, that distributed PV generation does not instantaneously disappear across the grid from environmental conditions, as the HECO Companies suggest, see HECO Companies' Attach. 1 at 6-9. In fact, many studies establish that a fleet of geographically distributed PV systems collectively results in a smoothing or cancelling effect of the variations at any one location. Lenox Dec ¶¶ 8, 12; see also Exh. 4, attached hereto. Just as the load profile that system operators use to plan their operation of the grid is much smoother than the load profile of any single customer, the output profile of a fleet of distributed PV systems is much more uniform than that of an individual system. Lenox Dec. ¶ 8. See also Exh. 2 at 2 (Dr. Alvarado) (recognizing that the "impact on system reliability of distributed renewable generation is much milder, in part thanks to geographic diversity (even within a single island)"). "This effect only increases as more distributed PV is added to the grid." Lenox Dec. ¶ 8.

The research literature also shows that this smoothing effect increases at the finer timescales relevant to grid operation issues, and also increases as the geographic dispersion of the sites increases. Id. ¶ 9. Specifically:

- Appreciable geographical diversity has been observed within the footprint of a single 30 kW system on a 1 second basis.

- Large reductions in variability have been observed within larger (multi-MW) sites on a 10-second basis and more modest reductions on a 1-minute basis.

- Research shows zero correlation coefficients for sites as close as 20 km apart on a 1-minute and 10 minute basis.

- Moreover, over longer time intervals, such as on an hourly scale, ambient weather conditions such as clouds have less effect on variation in distributed PV systems than predictable or forecastable trends such as the movement of the sun.

Id. ¶¶ 9, 11.

SA/HSEA's expert on solar power systems analyzed data from a limited sample of five existing PV systems on the HELCO grid, which confirmed results consistent with those found everywhere else and demonstrated (1) the smoothing effect on aggregate output, and (2) a general lack of correlation in output across sites. Id. ¶¶ 10, 13-14; Exhs. 5 & 6, attached hereto. The smoothing effect may actually apply to an even greater extent in Hawai'i, which includes a wide range of micro-climates on the individual islands, as opposed to the mono-climates in mainland areas. Lenox Dec. ¶ 10.

In addition to completely disregarding the research literature on this issue of PV system output smoothing induced by geographic diversity, the HECO Companies also failed to acknowledge other examples of PV's specific and beneficial characteristics:

> For example, PV typically produces power when the load on the system is large, meaning it is less likely than wind to cause excess energy problems relative to the minimum operational levels of the HECO Companies' base load generators. In other words, it operates at times when the utility has higher load, solar has smaller penetration relative to total generation, and

> base load generation is not running near its minimum levels. This mitigates concerns regarding both the availability of reserves and the potential for "curtailment" of existing renewable energy generation.

Lenox Dec. ¶ 7. See also Exh. 2 at 2 (Dr. Alvarado) (maintaining that solar power "is highly predictable within some bounds due to cloud cover" and "in most systems . . . is highly correlated with demand when air conditioning loads are involved").

In sum, the HECO Companies failed to provide any information on PV systems and simply sought to treat all renewable DG from a simplistic, single plant perspective. They have not justified any HECO Caps and Limits on any renewable DG, especially PV systems.

B. Curtailment.

The HECO Companies' argument based on curtailment is equally transparent in their overzealous attempt to prejudice and obstruct renewable DG. It should be made clear that curtailment is the predominant basis offered by the HECO Companies for their proposed interim Caps and Limits on the MECO and HELCO grids. See Response to BP-HECO-IR-10 (acknowledging that the Limits on those grids are "due primarily to curtailment concerns"). This analysis, however, is so manifestly skewed towards the desired end result that it ends up disproving itself.

The HECO Companies provide load duration curves showing percentages of estimated "possible" curtailment under existing conditions, but admit that the curtailment occurs "primarily during the off-peak times of day" HECO Companies' Attach. 4 at 2; see also Response to SA/HSEA-RS-IR-34 (acknowledging that excess energy curtailment "generally occur during off-peak hours," and that "[o]n-peak curtailments for the hours referenced, occurred infrequently as necessary due to [non-excess energy conditions]"). After numerous failed requests for the actual data on curtailment for excess energy, the HECO Companies finally provided data in responses to supplemental IRs. SA/HSEA join in Blue Planet Foundation's comments based on its expert analysis of this data, which shows the overwhelming percentage of existing curtailment occurs off-peak hours at night, when PV systems do not generate energy.

The Commission expressed concern over projects that would "markedly increase curtailment" of renewable projects. D&O at 50 (emphasis added). The HECO Companies, however, distort that standard to block FIT projects wholesale where they may cause any curtailment, however infrequent or unlikely. Such a draconian standard that would, for example, forfeit all of the daytime clean energy benefits of solar power systems because existing generation is sometimes curtailed at night, or because of the possibility that a small fraction of existing generation may be curtailed during the day, would eviscerate the FIT program and Hawai'i's clean energy goals.

Unable to justify their proposed Caps and Limits based on the status quo, the HECO Companies proceed to "stacking" their charts, literally and figuratively, against renewable DG, including in their stack charts several large "anticipated" projects, then arguing that the addition of these projects leaves no further room for DG systems. These projects include: "8 MW of geothermal and approximately 24 MW of biomass energy" or a total 36 MW for HELCO, HECO Companies' Attach. 4 at 15; and a total of 42 MW from two wind farms for MECO, id. at 9.

Even assuming the HECO Companies' figures for "minimum" "must-run" generation as a given, but see HECO Companies' Exh. 1 at 24 (recognizing that "an assessment should be performed to reevaluate operational requirements for must-run units and reserves considering the future anticipated generation mix"), their stack charts go too far. First, they assume maximum generation from every dispatchable renewable system, but provide no support on the likelihood, if any, of all these systems simultaneously and constantly producing at their maximum outputs.[7]

The HECO Companies' curtailment argument ultimately rests, and falls, on the addition of the maximum outputs of large proposed projects. See Response to TPL-HECO-IR-11 (stating that "with consideration of future resources, the HELCO system cannot accommodate all possible renewable energy resources"); Response to SA/HSEA-RS-IR-19 (stating that "[w]hen the planned wind additions are considered," MECO's grid-wide percentage of variable renewables will exceed HELCO's). The HECO Companies refuse to provide any details on the proposals, see Response to TPL-HECO-IR-13; Response to SA/HSEA-RS-IR-23, but instead simply presume them as a fait accompli. Even though the HECO Companies apparently prefer to stake everything on these proposals, sacrificing the immediate benefits of the FIT program in the bargain, the proposals may not be as certain as the HECO Companies suggest. In effect, the

[7] It is unclear, for example, how long Puna Geothermal Venture on the HELCO grid has produced at the maximum output of 30 MW the HECO Companies include in their stack charts, see Response to TPL-HECO-IR-9(A); Attach. 4 at 15;. Public statements by PGV indicate that the company has had difficulty producing the full amount and is currently generating only 17 MW. See, e.g., < http://www.punageothermalventure.com/News/53/geothermal-venture-in-bind>; < http://www.prnewswire.com/news-releases/ormat-technologies-provides-puna-power-plant-update-83544962.html> (last visited March 23, 2010).

HECO Companies improperly seek to make a definitive procurement decision in favor of these proposals and against any renewable DG on the MECO and HELCO grids, without any supporting information or showing of need or prudence. The Commission has already made its decision regarding the procurement of renewable resources via the FIT program, and the HECO Companies are in no position to override this.

The HECO Companies, again, run headlong into a fatal contradiction by proposing to block almost only distribution-level projects, but not the large, transmission-level projects.[8] The HECO Companies admit their curtailment analysis includes only the large proposed projects, and not any future DG. Response to BP-HECO-IR-24. Thus, they seek to block DG projects to avoid what they deem forbidden curtailment, but only after assuming the addition of large transmission-level projects, which will create the curtailment problem (and themselves cause curtailment).[9] The proposals -- 36 MW for HELCO and 42 MW for MECO -- are more than three to four times the initial 10 MW FIT program caps that the Commission established for those grids. The HECO Companies provide no basis for blocking renewable DG based on a premature assumption or mere preference for other projects. No such basis exists.

[8] Again, these large projects ironically include large, centralized wind projects of the same type that the HECO Companies claim produce the reliability problems that justify their Limits on renewable energy.

[9] Although the HECO Companies are unclear in their report, they indicate in recent responses to IRs that they curtail resources in reverse order of "seniority," beginning with the most recent project, measured by the date of the Commission's approval. See Response to PUC-IR-319. Thus, the curtailment indicated in the HECO Companies' stack charts would apply to the most recent projects, which in those charts are proposed projects not yet in existence. Thus, any curtailment by FIT projects would not affect "existing" projects, but potential future projects, which is not a proper basis for blocking FIT projects under the Commission's D&O.

VII. THE HECO COMPANIES' PROPOSED LIMITS WILL HARM HAWAI'I'S RENEWABLE ENERGY INDUSTRY

Finally, while the HECO Companies speculate and tergiversate over the impacts of renewable energy on their grids, SA/HSEA wish to make clear that the impacts of their proposed Limits on the Hawai'i's indigenous solar industry would be rapid, disastrous, and pervasive. See Duda Dec. ¶¶ 4-14. Hawai'i is currently one of only a handful of U.S. states with a viable market for distributed PV, due to a favorable combination of incentives and energy cost offsets for Hawai'i homeowners and business owners. Id. ¶ 5. This market has grown steadily from a very low base since around 2001, spurred by the introduction of NEM. Id. ¶ 6. Notably, 2009 installations were roughly equal across all three of the HECO Companies, although the MECO and HELCO systems are smaller than the HECO system. Id.

Currently, the program cap on NEM is at three percent of system peak load for MECO and HELCO and one percent for HECO. Id. ¶ 7. As mentioned above, in 2008, the HECO Companies and Consumer Advocate proposed, and the Commission approved and ordered, an increase to three percent on the MECO and HELCO grids, with an automatic increase to four percent once one of a number of triggers are met. The HECO Companies, however, now propose limiting NEM to three percent on the MECO and HELCO grids while their proposed Working Group studies reliability issues over a timetable that stretches until the end of June 2011, but see supra note 4. The HECO Companies also maintain their opposition to allowing the FIT program to proceed for MECO and HELCO.

Without access to NEM or FIT, the Hawai'i-based solar industry on these islands will rapidly collapse; this will occur even if several one-off transmission-level projects may be constructed through another procurement mechanism. Duda Dec. ¶ 8. To date, Hawai'i-based companies have developed the overwhelming share of NEM projects. Id. ¶ 10. Increased revenues, however, have not translated into increased profitability; rather, to keep up with the growth in PV demand, Hawai'i-based companies have had to reinvest their earnings in their businesses. Id. In short, these businesses have stepped up their role in Hawai'i's ongoing clean energy movement and, as a result, are not capitalized to survive interruptions in that movement. Id.

Such an interruption will have far-reaching impacts not only on the industry, but the state as a whole. Distributed PV is an engine of economic growth for Hawai'i at several levels:

- At the most macro level, the reduction in the need to purchase fuel to produce power keeps additional resources flowing within Hawai'i's economy, rather than exiting the state to pay for petroleum.

- At a micro-economic level, businesses use solar power to reduce and hedge a key component of operating costs. A business owner who can eliminate the cost of power has funds available to reinvest in his/her business, thus further stimulating Hawaii's economy. The same is true of homeowners, who have additional discretionary income to spend locally if they are freed from the need to buy ever more costly grid power each month.

- The solar industry also direct spillover benefits of job growth and construction spending. Although precise data on the Hawai'i solar market is undeveloped, based on the $118 million in PV permits pulled on O'ahu (up from $85 million in 2008), and applying the State's macroeconomic modeling factors, the solar industry is responsible for more than 1,330 jobs on O'ahu alone. Given that installations occur disproportionately on the neighbor islands, the estimated total job count associated with the Hawai'i-based PV industry is approximately 2,000.

Id. ¶¶ 11-13.

In sum, putting renewable DG on hold on the MECO and HELCO systems or slowing it down on the HECO system will have numerous immediate negative consequences for Hawai'i-based businesses and their employees and Hawai'i's homeowners and business owners. Id. ¶ 14. These include job losses and business failures in the solar industry, increased expenses for other business owners and for homeowners and decreased consumer choice, as well as continued vulnerability of the state to fluctuations in global oil markets.

In its D&O, the Commission emphasized the "value in encouraging a diverse local industry of renewable energy developers, installers, and operators, and want[ed] to ensure that the FIT, in conjunction with [NEM], supports small commercial and residential projects." Id. at 57. The HECO Companies' proposed limits on renewable DG directly subverts these values without valid justification, and should be rejected.

VIII. CONCLUSION

For more than a year, the parties and the Commission have invested considerable time and resources to develop a successful FIT program for the State of Hawai'i. The Commission has set forth ambitious principles for the program that would establish it as a model for other jurisdictions. Everyone has come too far to have the HECO Companies preemptively shut down the FIT program, along with NEM, on the MECO and HELCO grids based on generalized and inflated arguments and an overall failure of vision. For the reasons discussed above, SA/HSEA respectfully request the Commission to reject the HECO Companies' proposed limits on the FIT program and renewable distributed generation.

DATED: Honolulu, Hawai'i, March 23, 2010.

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EARTHJUSTICE
Attorneys for:
HAWAI'I SOLAR ENERGY
ASSOCIATION

Respectfully submitted.

DATED: Honolulu, Hawaii,

RILEY SAITO

for The Solar Alliance

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAIʻI

In the Matter of PUBLIC UTILITIES COMMISSION Instituting a Proceeding to Investigate The Implementation of Feed-in Tariffs.	)	Docket No. 2008-0273

DECLARATION OF FERNANDO L. ALVARADO, PH.D.

1. I am a Professor Emeritus of the Department of Electrical & Computer Engineering at the University of Wisconsin-Madison. My professional affiliations include: Fellow of the Institute of Electrical and Electronic Engineers (IEEE), former Chairman of the Energy Policy Committee for IEEE-USA, and Member of the Power and Energy Society of IEEE. I have decades of national and international experience in the field of power systems and power systems operations, which includes work on considering the impact of solar and wind projects on systems and analyzing island power systems. A condensed version of my Curriculum Vitae is attached as Exhibit 1.

2. I have reviewed the Hawaiian Electric utilities' "Report on Reliability Standards" dated February 8, 2010 and related materials. I have prepared a statement in response, which is attached as Exhibit 2.

I declare under penalty of law that the foregoing is true and correct.

Dated: Kailua-Kona, Hawaiʻi, March 20, 2010

FERNANDO L. ALVARADO, PH.D.

EXHIBIT 1

Fernando L. Alvarado

RESUME

October 2009

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Academic Background:

Ph.D., University of Michigan-Ann Arbor, 1972, Engineering
M.S.E.E., Clarkson University, New York, 1968, Engineering
P.E., National University of Engineering, Lima, Peru, 1967, Engineering
B.E.E., National University of Engineering, Lima, Peru, 1966, Engineering

Positions Held:

Senior Consultant, Laurits R. Christensen Associates, Inc., 1996-present
Professor Emeritus, The University of Wisconsin, 2003-present
Assistant, Associate, and Professor University of Wisconsin-Madison, 1975-2003
Assistant Professor, University of Toledo, Ohio, 1972-1975

Selected Professional Activities:

Fellow of IEEE
Chairman, IEEE-USA Energy Policy Committee, 2002 and 2005
Member of the DOE Power Outage Study Team, 1999/2000
Advisor to the Presidential Commission on Critical Infrastructures, 1997-1998
Convenor, CIGE Task Force 38.05.07, Methods and Tools for Ancillary Services, 1998-2000

Professional Experience:

Fernando was a Professor of Electrical and Computer Engineering at the University of Wisconsin in Madison for many years. He became a professor emeritus in 2003 after almost 30 years of service. During his time there he taught many courses in the area of power systems, power system operations, large scale computation as applied to power and other large scale computational issues. Fernando continues to teach short courses, with an emphasis on voltage problems in power system, the management of congestion in grids, and problems associated with reserve and regulation needs in power system.

EXHIBIT 1

As a Senior Consultant for Christensen Associates, Fernando's job is to advise clients about issues pertaining to congestion management and related topics. These issues are often in conjunction with prospective or ongoing solar or wind energy projects.
During his two terms as chairman of the IEEE-USA Energy Policy Committee, the main issues Fernando dealt with were the management of voltage and reactive power in market-driven systems and issues associated with the impact on the system as a result of introduction into Plug-in Hybrid Electric Vehicles (PHEVs).

Major Projects he as participated in consulting:

Software for optimal resource expansion for a European network (including the optimization of the use of reactive power resources, 2002/2003).

The use of Nomograms to represent power system limits in market environments. Work done for DOE (2002).

Power deliverability analysis (work done for a U.S. utility, 2002).

Estimation of Generator Costs and Network Locational Prices for a major foreign distribution company (1996/1997)

Research on Electricity Reserve Services. (2000)

Optimal Power Flow Network Modelling for a major U.S. utility (1997)

Tariff Project for an Eastern European Country (1998)

Reserve Customer Costing Demonstration Model for an Eastern Utility

Network Cost Evaluation and Transmission Tariffs (2000)

Costing and Pricing Ancillary Services for an Eastern Utility (1998)

Valuation of Ancillary Services (1996)

Inclusion of Transmission Reliability Costs in Real Time Pricing Decision (2001)

Selected Publications during his career (over 250 total)

"Reserve Services and Transmission: Responding to Energy and Reserve Prices," Presentation at the Next Generation of Unit Commitment Models' Kluwer Academic, 2001, (with R. Rajaraman, L. D. Kirsch, and C. Clark).

"Designing Incentive Compatible Contracts for Effective Demand Management," IEEE Transmission on Power Systems, Vol. 15, No. 4, November 2000, pp. 1255-1260, (with M. Fahrioglu).

"Understanding Price Volatility in Electricity Markets," Hawaii International Conference on System Sciences, January 2000, Maui, Hawaii, (Best Paper Award), (with R. Rajaraman).

"Inefficiencies of NERC's Transmission Loading Relief Procedure," *The Electricity Journal*, Elsevier Publishers, pp. 47-54, October 1998, (with R. Rajaraman).

"Determination of Location and Amount of Series Compensation to Increase Power Transfer Capability," *IEEE Transactions on Power Systems*, Vol. 13, No. 2, May 1998, (with R. Rajaraman, A. Maniaci, R. Camfield, and S. Jalali).

"Management of Multiple Congested Conditions in Unbundled Operation of a Power System," 1997 PICA Conference Proceedings, pp. 374-380, *IEEE Transactions on Power Systems*, 1998, (with H. Glavitsch).

"The Sensitivity of the Loading Margin to Voltage Collapse with Respect to Arbitrary Parameters," *IEEE Transactions on Power Systems*, Vol. 12, No. 1, February 1997, (with S. Greene and I. Dobson).

"Matrix Enlarging Methods and their Application," *BIT* Vol. 37, No. 3, 1997, pp. 473-505. The subject matter of this paper has resulted in a Patent.

"Rules of The Road and Electric Traffic Controllers: Making a Virtual Utility Possible," S. Awerbuch and S. Preston, editors, Kluwer Academic Publishers, 1997, (book chapter).

"Constrained LAV State Estimation using Penalty Functions," accepted for publication in *The IEEE Transactions on Power Systems*, 1997. One of several papers on the subject of state estimation, a key component of a modern power system control center, (with H. Singh and W. Liu).

"Technical Foundations for Pricing Security," in *Service Opportunities for Electric Utilities: Creating Differentiated Products*, S. S. Oren and S. A. Smith, eds., Kluwer Academic, Publisher, 1993, pp. 122-146. This book chapter is one of several works by Dr. Alvarado that have lead to a new approach leading to the integration of modern economic theory and traditional power system engineering.

"Sparsity in Large-Scale Network Computation," in *Advances in Electric Power and Energy Conversion System Dynamics, and Control*, C. T. Leondes, editor, Academic Press, 1991. This book chapter is considered by many to be the definitive work on large scale computation in Power Systems, with ramifications beyond power systems, (with W. F. Tinney and M. K. Enns).

"Penalty Factors from Newton's Method," *IEEE Transactions on Power Apparatus and Systems*, Vol. PAS-97, Nov/Dec 1978, pp. 2031-2040. This paper is considered by some to be the classic reference on the subject of determination of optimal economic operating conditions in power system transmission.

EXHIBIT 2

Exhibit 2

A vision for Renewable Energy in Hawai'i and a comment on HECO's proposal

Fernando L. Alvarado, Ph.D., Professor Emeritus, University of Wisconsin

3/20/2010

I am a recognized expert in the area of power systems and power systems operations. I am a professor emeritus at the University of Wisconsin, former chairman of the Energy Policy Committee for IEEE-USA, a fellow of the Institute of Electrical and Electronic Engineers (IEEE) and a member of the Power and Energy Society of IEEE. I have made Hawaii my home, dividing my time between Wisconsin and Hawaii each year. I was dismayed but by no means surprised to see the proposal from HECO to place a moratorium on renewable electrical power.

I have a vision. My vision is that it is possible for the State of Hawaii to go, not 70%, but actually 100% renewable in the not too distant future if it chose to do so. Furthermore, it is even possible for such a 100% renewable system to be even *more* reliable than the current system[1]. The only questions in my mind are the cost, the political courage to make it happen, the acceptance by the public of a new way of understanding the electricity supply, and how quickly should the change take place.

The arguments brought forth by HECO are in part the result of application of the NERC reliability standards that were made the law in order to avoid uncontrolled major blackouts in the mainland. There are, however, numerous other ways to attain reliability that are not properly considered within the HECO arguments. HECO seems to take it as a given that the future will look like the past: a central utility that charges fixed rates to "ratepayers," as if ratepayers were passive objects that are there just to consume and pay the assigned fixed rates. This way of thinking about the utility business is what brought about stagnation to innovation in the mainland, and it is the primary reason why in many parts of the country utilities were restructured into a more competitive and innovative mold. The lack of innovative thinking in the business is precisely what is at stake here.

There is no question that greater penetration of renewables beyond a certain level will create reliability problems within the present grid structure unless something is done. However, solving the problem by reducing the penetration of renewable energy is entirely the wrong solution to the problem. By failing to ask the question of "how do we integrate large amounts of renewables into the grid" and replacing it with the question of "how many renewables can our system take before we are forced to change the way we operate the system and charge for electricity" HECO is changing the game plan from one of innovation to one of preserving the status quo.

Let me offer a few practical short term suggestions that address some of the concerns raised by HECO. HECO's assumptions made when proposing to severely limit the penetration of solar and other renewables have several flaws. In my experience with other "island systems," the biggest single factor in determining reliability is not the

[1] I have also completed a "sanity analysis" to back up the claim that is it indeed possible to go 100% renewable in the not too distant future. I will be happy to share this analysis with interested parties.

EXHIBIT 2

existence of distributed generation (renewable or otherwise) but the size of the largest conventional generator. The system must be able to absorb the unpredictable and instantaneous outage of this generator at any time. The alternatives to prevent outages when this happens include having a lot more "spinning reserves" (generators that are on-line but not operating at their maximum output), under-frequency load shedding (which is an often involuntary disconnection of part of the load to limit the extent of outages in emergencies), and contractual disconnection schemes for some customers and loads. It is also possible to provide sufficient conventional quick-start generators to serve as backup, whether these are provided by the utility or by the end customers.

In contrast, the impact on system reliability of distributed renewable generation is much milder, in part thanks to geographic diversity (even within a single island). Geographic diversity gives a greater opportunity to respond than the sudden outage of a single large generator. One would have a few minutes to start backup generation or disconnect certain loads. Solar power is variable, yes, but it is also highly predictable within some bounds due to cloud cover. Furthermore, in most systems solar power production is highly correlated with demand when air conditioning loads are involved. While the correlation is not perfect and there are delays that need to be considered, nonetheless there is good correlation.

The other "down side" of renewables that is not explicit in HECO's concerns is its presumed lack of dispatchability and its presumed inability to itself provide reserves. To the extent that this unspoken concern is of importance to HECO, it is important to identify it as a separate and distinct concern, not part of "energy production." Rather it is part of the "frequency regulation" and "reserve provision" needs of HECO. Once this is recognized, the issue can be addressed on its own merits.

For the concerns regarding frequency regulation, it is possible to operate inverter controls so they have a limited ability to respond to frequency. It is even possible for renewable energy inverter controls to be operated so they can provide reserves to help back up conventional generation!

It is also possible for HECO to greatly expand their contracts with customers to provide voluntary reserves and voluntary frequency regulation. Large customers that have standby or emergency generators can be called upon to be disconnected during temporary under-supply conditions. Even retail end users can be persuaded to participate in sufficiently creative such programs. Contracts need not require complete disconnections. Temporary water heater and a/c disconnection programs can go a long way to provide system reserves not just for renewables, but also for conventional generator operation. Present-day technologies are already capable of enabling large percentage penetration of renewables, particularly solar, even without the much needed structural changes.

To their credit, HECO has looked at the impact of load shedding and changing the settings for under-frequency relay settings as a means of accommodating more renewables. This is a step in the right direction. They just have not gone far enough.

Please direct any questions or comments on the above remarks to:

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flalvarado@gmail.com
75-6040 Ali'i Dr #211
Kaillua-Kona, HI 96740

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAIʻI

In the Matter of	)	
	)	
PUBLIC UTILITIES COMMISSION	)	Docket No. 2008-0273
	)	
Instituting a Proceeding to Investigate	)	
The Implementation of Feed-in	)	
Tariffs.	)	

DECLARATION OF CARL LENOX

1. I am the Principal Engineer in the Research and Development Group of SunPower Corporation, an international solar energy company. I have a B.S. in Mechanical Engineering from the University of California, San Diego and over ten years of experience in the areas of solar energy and energy efficiency in diverse roles including product development and certification, codes and standards development, performance modeling, and testing and reliability. In my position at SunPower, I am responsible for a wide spectrum of activities related to photovoltaic ("PV") variability, grid integration, energy storage, and advanced communications and controls for PV systems. This involves interfacing with the entire range of internal and external subject matter experts, technology vendors, customers, and other stakeholders including utilities, system operators, consultants, and researchers in academia and the national labs. I am actively engaged in

numerous collaborative activities related to PV variability and grid integration. These include the NREL-led PV Variability Ad-Hoc Working Group, the NERC Integration of Variable Generation Task Force (IVGTF), the DOE Solar Vision 2030 drafting committee, and the WECC PV Modeling Task Force. A true and correct copy of my Curriculum Vitae is attached hereto as Exhibit 3.

2. I have reviewed the documents filed by Hawaiian Electric Company, Inc. ("HECO"), Hawaii Electric Light Company, Inc. ("HELCO"), and Maui Electric Company, Ltd. ("MECO") (collectively, the "HECO Companies") regarding reliability standards for the Hawai'i Feed-in Tariff program, particularly the report filed on February 8, 2010. The report makes several misleading and inaccurate representations about PV distributed generation ("DG"), which I would like to clarify and correct for the record.

3. In the February 8 document, the HECO Companies refer to an "absence of data" on variable DG impacts and states that "[t]he typical capacity factors for PV resources of various sizes, variability due to environmental and weather patterns, and correlation between sites are not known." HECO Companies' Exhibit 1 at 40. While this topic is certainly the subject of active research, a wealth of data has been and is being developed on each of these issues by the solar industry, academia, and the national laboratories, and much of it is publicly available in published reports and journals. Moreover, this builds on a

very extensive body of work developed on wind energy systems which conclusively demonstrates substantial reductions in variability due to geographical mitigation. Findings to date indicate comparable reductions in variability for spatially distributed PV systems. These bodies of work directly contradict the basic assumptions the HECO Companies make regarding PV systems.

4. The HECO Companies, for example, analyze for the HECO system "various levels of DG PV penetration -- 5%, 10%, and 15% -- in combination with two different scenarios of sudden loss of aggregate PV generation, one in which 25% of the island-wide installed PV output is lost and another in which 50% is lost." HECO Companies' Attachment 1 at 6. The HECO Companies are unclear, but suggest that such a sudden loss may be due to environmental conditions.

5. It should be made clear that a "sudden" or instantaneous loss of 25% or 50% of all distributed PV island-wide due to environmental conditions is not a realistic scenario. Excepting a full solar eclipse -- the timing of which is, of course, highly predictable -- I have never seen or heard of such a phenomenon anywhere in the literature or in the field.

6. The only way that such mass loss of distributed PV could occur is in the case of an abnormal grid operating event, such as a loss of a large, centralized plant causing an under-frequency excursion, which may then cause PV systems to trip offline simultaneously and island-wide. I understand that the HECO

Companies have addressed this concern by requiring the frequency trip settings of PV system inverters to be set below the load shed frequency triggers for HELCO and MECO, and are considering the same for HECO. In this context, PV systems provide a grid benefit by supporting load and mitigating further frequency drops if configured to remain online during contingency events.

7. The HECO Companies propose grid-wide limits on DG. This blanket proposal fails to account for the differences in DG resources. PV has characteristics that distinguish it from other DG technologies, and which in general are desirable. For example, PV typically produces power when the load on the system is large, meaning it is less likely than wind to cause excess energy problems relative to the minimum operational levels of the HECO Companies' base load generators. In other words, it operates at times when the utility has higher load, solar has smaller penetration relative to total generation, and base load generation is not running near its minimum levels. This mitigates concerns regarding both the availability of reserves and the potential for "curtailment" of existing renewable energy generation.

8. Moreover, distributed PV is not as variable as the HECO Companies suggest. Many previous and ongoing studies establish that distributed PV systems collectively result in a smoothing or cancelling effect on the variations at any one site. Published examples of this work include Mills et. al. 2009, Hoff et. al. 2008,

Kawasaki et. al. 2006, and Weimken et. al 2001. Stated another way, just as the load profile that system operators use to plan their operation of the grid is much smoother than the load profile of an individual customer, distributed PV systems have a similar effect of smoothing the diverse output between separate systems. This effect only increases as more distributed PV is added to the grid.

9. The studies also show that this smoothing effect generally increases at the finer temporal resolution relevant to grid operation and also increases as the geographic dispersion of the sites increases. This is associated with reductions in correlation towards zero between changes in output at different sites between measurement timesteps. Appreciable geographical diversity has been observed within the footprint of a single 30 kW system on a 1 second basis. Large reductions in variability have been observed within larger (multi-MW) sites on a 10-second basis and more modest reductions on a 1-minute basis. Research shows zero correlation coefficients for sites as close as 20 km apart on a 1-minute and 10 minute basis.

10. Data analyzed and presented for this filing, discussed below, is an example of low correlation coefficients for sites on Hawai'i Island separated by as little as 10 km on a 15 minute basis and demonstrates that the same principles hold in Hawai'i. In fact, the smoothing effect may apply even more in Hawai'i, which

includes a wide range of micro-climates on the individual islands, as opposed to the mono-climates in mainland areas.

11. Over longer time intervals such as on an hourly scale, changes in insolation due to clouds will still be less correlated than changes due to larger trends such as the movement of the sun. This means that in longer time intervals, ambient weather conditions will have less effect on observed variation in distributed PV system performance across even geographically dispersed systems than predictable or forecastable factors such as the movement of the sun.

12. Attached hereto as Exhibit 4 is a true and correct copy of an excerpt from a 2008 report by Hoff et al. that illustrates the effect of geographical dispersion on PV output variability. Note the dramatic decrease in one-minute variability in the case of 20 PV sites, as opposed to a single site. This plot is representative of the findings of the previously cited body of research.

13. The Solar Alliance and Hawai'i Solar Energy Association obtained time-series data from five existing distributed PV systems on the HELCO grid. The data are 15-minute production data over a single day (January 1, 2008) normalized to maximum output on that day. Attached hereto as Exhibit 5 is a true and correct graph showing the output at each site compared to the aggregate output of all sites. While this is a limited data set, results are illustrative of the expected smoothing effect. Analysis of these data shows that (1) geographic dispersion

reduces aggregate variability and (2) the geographically dispersed sites have a reduced tendency to vary in the same direction, at the same time. These results are consistent with those everywhere else the phenomenon has been studied. Note that the temporal scale is relatively coarse and that variation would be even less correlated at smaller time scales. In addition, three of the sites are actually fairly close together, serving to further reduce observed variability. Finally, there are mathematical limitations to the theoretical maximum reduction in variability possible when computed over only five locations. Increasing the number of locations, even within the same geographical region covered here (generally in the North-West quadrant of the Big Island), would be expected to result in further smoothing effects.

14. Attached hereto as Exhibit 6 is a true and correct copy of a plot of the correlations between the production at each site and the distance between sites for a single day on 15-minute intervals. A correlation coefficient of zero indicates that changes in production at two sites between two intervals are completely uncorrelated and changes are just as likely to occur at the opposite direction and magnitude as the same direction and magnitude; that is changes are completely random between the two sites. The first thing to note is that most of the points on the plot are closely grouped around zero on the vertical axis, indicating a general lack of correlation in production across sites. The second thing to note is that

correlation declines as distance increases. For example, the only point indicating significant correlation occurs among the two most geographically closely sited plants.

15. In sum, the distributed network of PV systems is not as variable and "unreliable" as the HECO Companies suggest, and provides distinct and important benefits that should recognized in Hawai'i's ongoing efforts to promote clean energy.

I declare under penalty of law that the foregoing is true and correct.

Dated: Richmond, CA, March 23, 2010

CARL LENOX

EXHIBIT 3

Carl Lenox
Principal Engineer, SunPower Corporation

Experience

SunPower Corporation (Richmond, CA)

09/09 – Present: Principal Engineer, Technology Development

The technology development role delivers technology / market analysis and strategy recommendations to SunPower's R&D, Product Management, and Policy teams and assists in external communication of SunPower's position on technical matters.

This includes assessment of opportunities and development of strategy related to the intersection of PV systems with the Smart Grid and energy storage, integration of distributed power electronics, as well as emerging interconnection requirements and standards and the implications for inverter features and functionality at all scales of deployment.

The latter task involves leadership of a cross-functional group which is addressing the challenges of integrating photovoltaic power plants into the utility system. This includes discussions with internal and external subject matter experts, technology vendors, customers, and other stakeholders including utilities, system operators, consultants, and researchers in academia and the national labs. Analysis of high-resolution PV output data to characterize variability and recommend mitigation strategies is also crucial component of this role, both as an individual contributor, and guiding the efforts of other team members.

Another component is participation in numerous collaborative activities related to PV variability and grid integration. These include the NREL-led PV Variability Ad-Hoc Working Group, the NERC Integration of Variable Generation Task Force (IVGTF), the DOE Solar Vision 2030 drafting committee, and the WECC PV Modeling Task Force.

Finally, development of strategic R&D partnerships is an important facet of this position. Most recently, built external and internal teams and contributed to six successful proposals under the CSI RD&D and DOE ARRA funding programs, and successfully executed a Cooperative Research and Development Agreement (CRADA) with Sandia National Labs. Total funding for these partnerships is approximately $5 MM.

6/04 – 09/09: Engineer - Sr. Staff Engineer, Product Development

Responsible for leading a cross-functional team charged with investigating, evaluating and creating long term roadmaps for alternate PV system power conditioning architectures.

This included technical assessment and value modeling of advanced inverter features and technologies, system-level controls, distributed power electronics, and emerging electricity storage technologies.

Also spearheaded SunPower's efforts to collect, analyze, and present analysis of high-resolution PV plant performance data from critical sites, including the largest installed PV system in North America at that time (Nellis AFB).

Previously, a key contributor to R&D efforts to achieve substantial reductions in cost, and improved performance, by designing integrated PV system solutions.

This included developing successful R&D proposals, and managing projects funded under programs including SunPower's Solar America Initiative ($25 MM funding) and Zero Energy New Homes ($2.7 MM funding) contracts.

EXHIBIT 3

In this role, led the successful development of two of SunPower's system products, SunTile and Smart Mount, and contributed numerous enabling innovations that are embedded across all SunPower's systems products and have resulted in the generation of significant IP.

In addition, leveraged PV-related fire testing knowledge gained from the SunTile program to provide critical input and guidance to the California State Fire Marshal PV Installation Guidelines, and subsequent DOE-funded fire testing and evaluation efforts under the auspices of SolarABCs.

<u>4/03 – 6/04: Engineer, Testing and Certifications</u>

Responsible for experimental design and implementation of diverse test programs related to weathering, mechanical loading, energy performance, and electrical safety. In this role, led a major outdoor corrosion test program and developed a core competency in mitigating atmospheric corrosion issues through proper material selection and design practices.
As the main point of contact with certification and testing agencies, worked closely with UL.

<u>9/01 to 4/03 – Engineer, Product Development</u>

Developed a novel PV-thermal hybrid solar collector from concept to production prototype. This included extensive materials and manufacturing process research and testing, as well as tooling and equipment design. Additionally, was responsible for data collection, analysis of system performance, and writing the final program report to the funding agency.

kW Engineering (Oakland, CA)

<u>3/00 – 9/01: Engineer</u>

Responsibilities at this energy efficiency consulting start-up included measurement, verification and auditing activities in the field, data analysis, HVAC performance simulations, and design of energy savings calculators in Excel for common commercial and industrial equipment retrofits.

National Technical University of Athens, (Athens, Greece)

<u>3/99 – 6/99: Test Engineer</u>

Short-term research position at the wind energy section in the Fluid Mechanics department. Responsibilities included the design, construction, and instrumentation of a wind turbine airfoil model, documentation, and instrument installation & calibration.

Solar Solutions LLC (San Diego, CA)

<u>7/97 – 3/99; 9/99 - 12/99: Engineer</u>

Developed an inexpensive, collapsible solar water distillation unit designed for use in the developing world. Primary responsibilities included product design and material selection, fabrication of prototypes, and test design and data analysis.

Other Relevant Skills & Experience

Project management, including budget and resource planning and product development processes; skilled in leading interdisciplinary teams to deliver to R&D milestones, often in the context of government-funded R&D programs.

Excellent written and verbal communication skills, with significant contributions to several major successful R&D contract proposals. Comfortable speaking to large audiences on technical topics. Speaker at Solar Power International 2009 on the Grid Integration panel, at the 2009 Utility-Wind Integration Group (UWIG) PV User Group Meeting, as well as at Solar Power International 2007 on Innovations in Balance of Systems. Participated in numerous presentations on PV variability to high-level invited audiences at SunPower, including the Solar Circle. Planned speaker at 2010 UWIG PV User Group meeting, 2010 PVSEC, and 2010 IEEE PVSC pending acceptance of abstracts.

Highly skilled in Excel, with a particular focus on data analysis and financial modeling, as well as JMP for statistical analysis.

Extensive use of SolidWorks for product design and development, from initial concepts to manufacturing drawings.

Well versed in product design for high performance and value in a constrained design space, utilizing a wide variety of materials including high-performance engineering polymers.

Education

12/98: BS Mechanical Engineering, UC San Diego.

Publications

"Understanding Variability and Uncertainty of Photovoltaics for Integration with the Electric Power System", Mills et. al. 2009 (co-author).

Issued Patents:

1) 7,530,830 "Misalignment Tolerant Connector"
2) 7,435,134 "Photovoltaic Module Mounting Clip with Integral Grounding"
3) 7,008,515 "Solar Water Still"

EXHIBIT 4

PHOTOVOLTAIC CAPACITY VALUATION METHODS

SEPA REPORT # 02-08

Tom Hoff, Clean Power Research

Richard Perez, State University of New York at Albany

JP Ross, Sungevity

Mike Taylor, Solar Electric Power Association

May 2008

Solar Electric Power Association

FACILITATING UTILITY USE AND INTEGRATION OF SOLAR ELECTRIC POWER

EXHIBIT 4

Relationship between PV Output Variability and Geographical Dispersion

Data from ARM climate research extended facility network spanning south central Kansas and north central Oklahoma was analyzed to perform a preliminary evaluation of the relationship between PV output variability and geographical dispersion

Figure 23 illustrates the variability in PV system output over short time durations for a single PV plant.

Figure 24 illustrates how increasing the number of PV locations from 1 to 20 reduces the short term variability. The graphs are based on a preliminary analysis of the ARM climate research extended facility network spanning south central Kansas and north central Oklahoma [9] and where data are recorded at a sampling rate of 20 seconds. The day was selected to represent highly variable conditions.

Whereas the minute-to-minute variability reaches 80 percent of maximum yield in the case of a single site, the variability is considerably reduced and barely exceeds 5 percent when 20 sites are bundled. Using hourly data would be inadequate in the one-site case, but appears acceptable in the multi-site case. This effect is not unlike the bundling of utility customers on the demand side where noisy individual loads add up to steady utility-wide loads.

Figure 23: One-minute irradiance and variability at one single location in the network

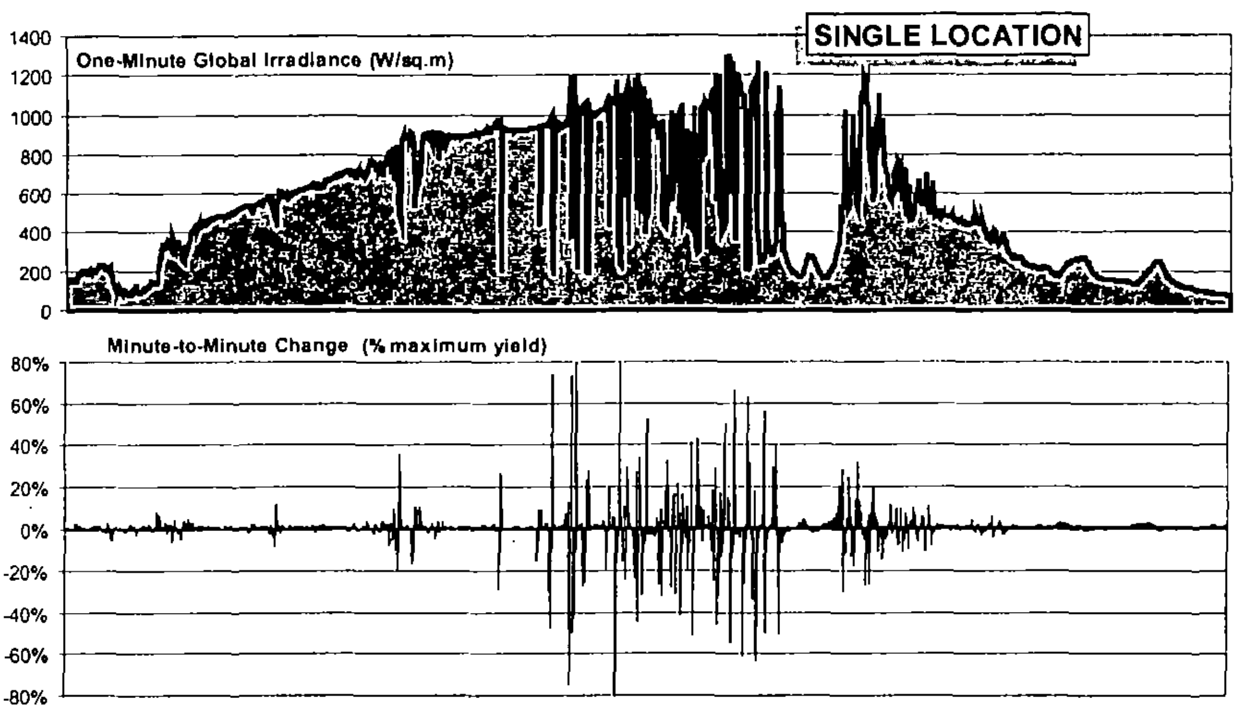

Figure 24: One-minute irradiance and variability from 20 bundled network stations.

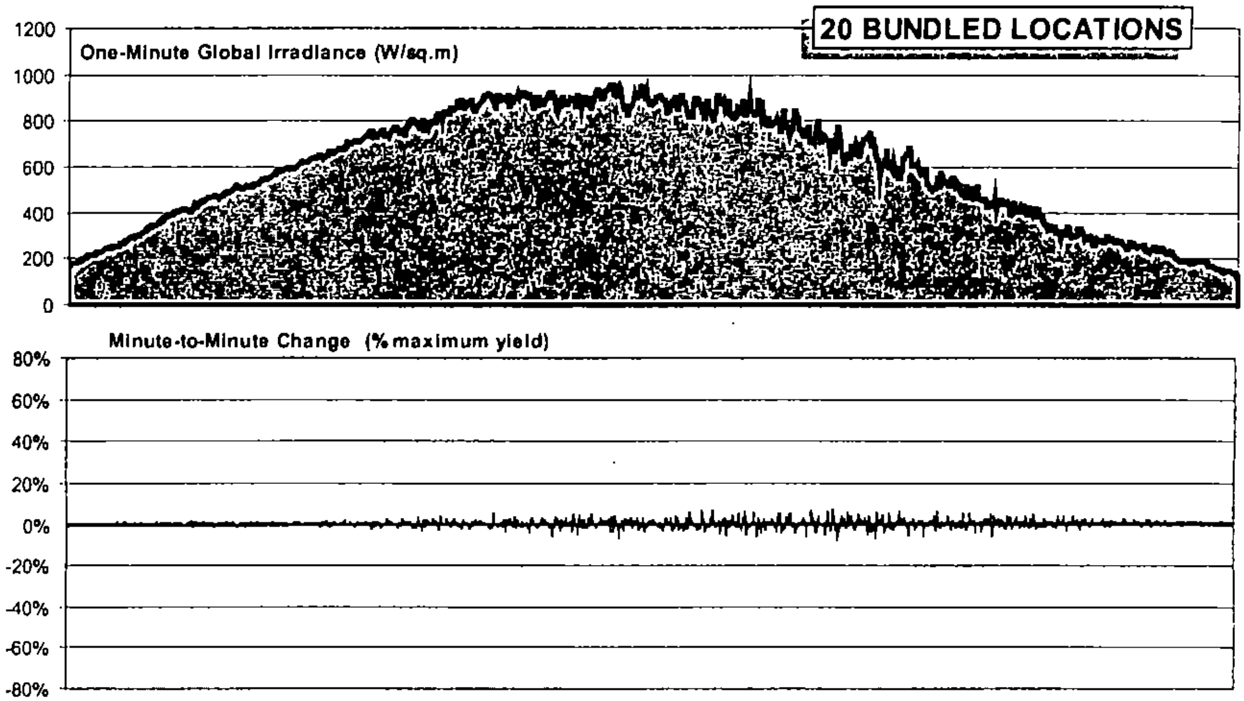

EXHIBIT 5

EXHIBIT 5

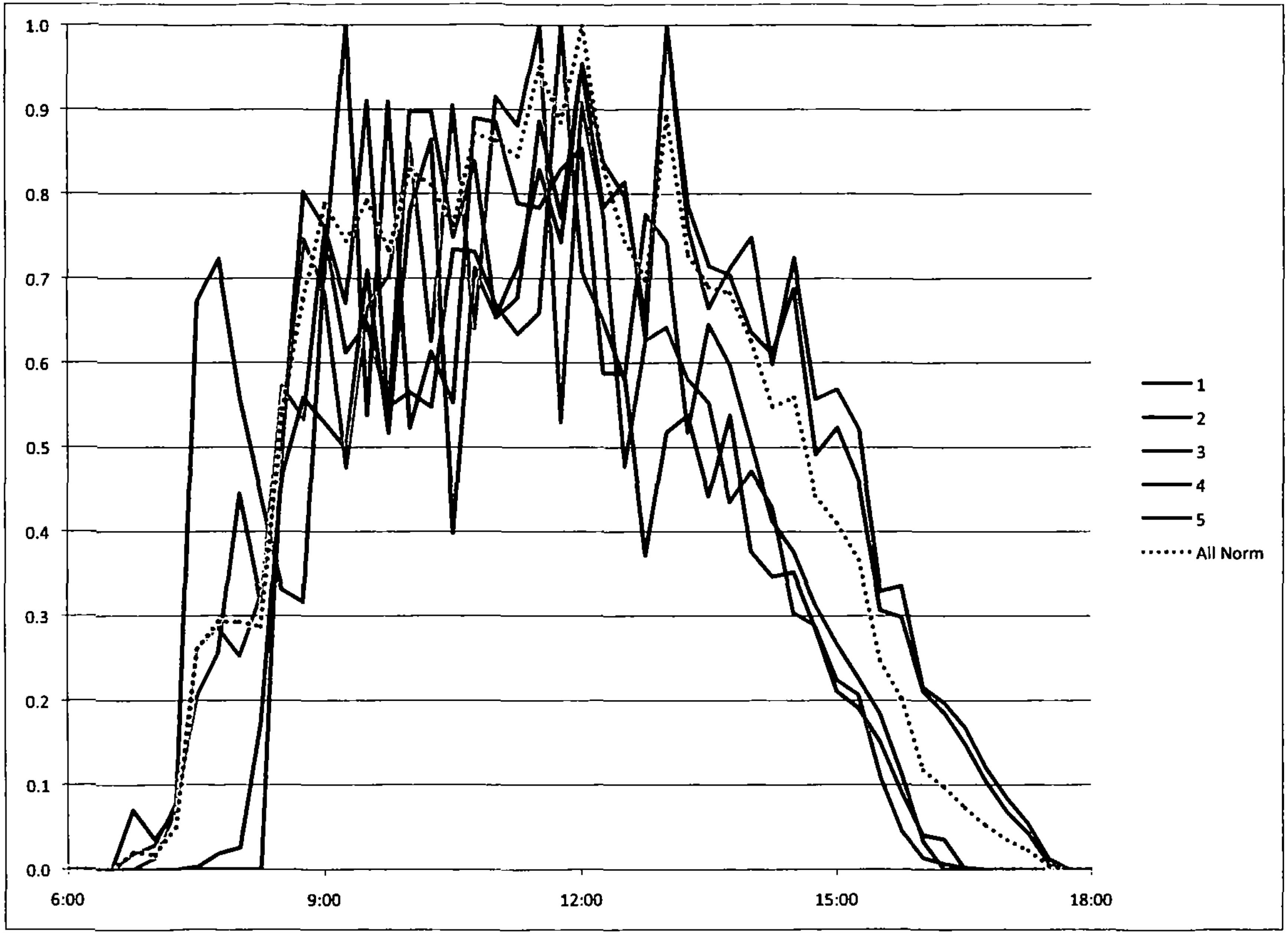

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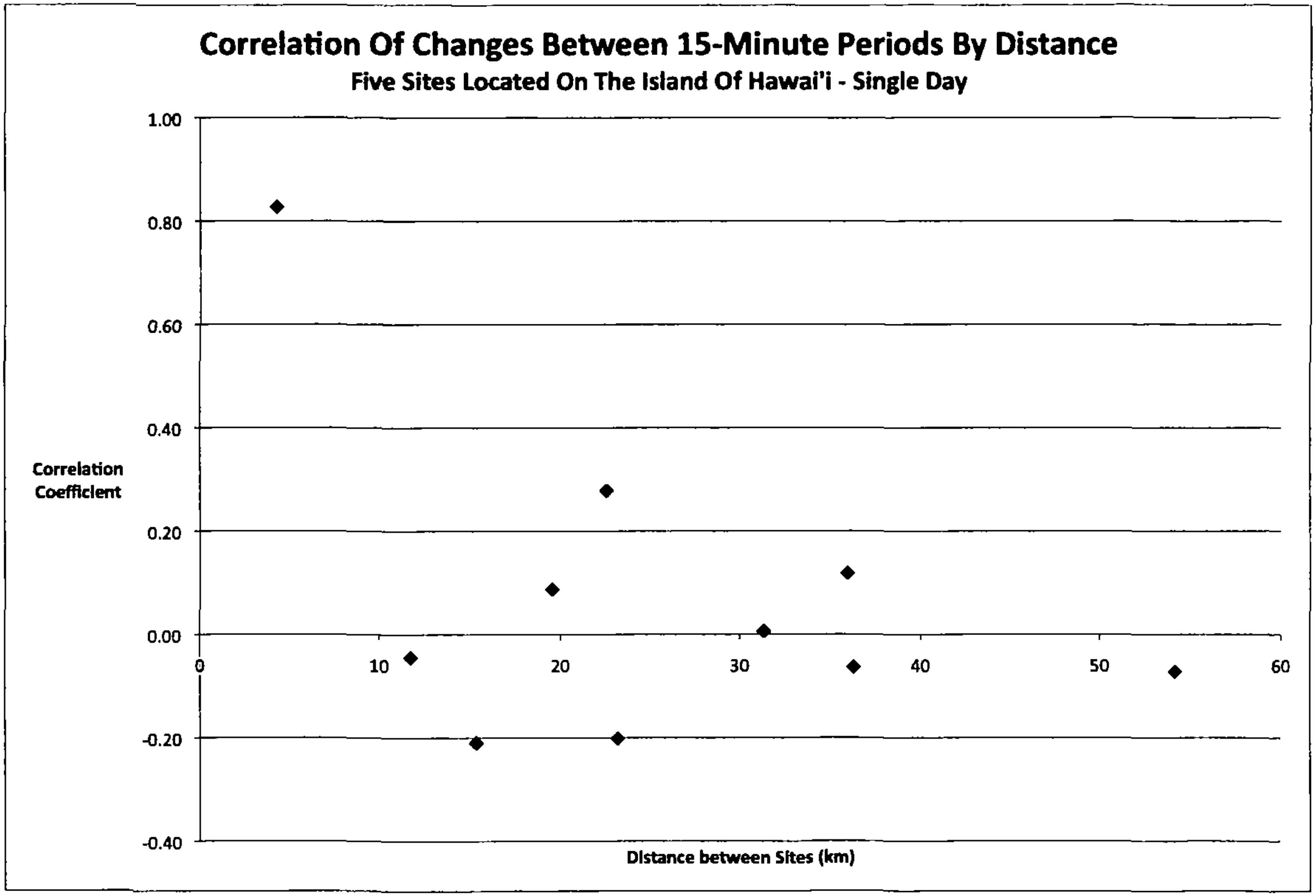
EXHIBIT 6



Correlation Of Changes Between 15-Minute Periods By Distance
Five Sites Located On The Island Of Hawai'i - Single Day
Correlation Coefficient
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
0
10
20
30
40
50
60
Distance between Sites (km)

EXHIBIT 6

[illegible]

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF HAWAI'I

In the Matter of	)	
	)	
PUBLIC UTILITIES COMMISSION	)	Docket No. 2008-0273
	)	
Instituting a Proceeding to Investigate The Implementation of Feed-in Tariffs.	)	

DECLARATION OF MARK DUDA

1. I am a founding member of Distributed Energy Partners, a Hawai'i-based renewable energy firm focused on the commercial, non-profit and government markets, and RevoluSun, a Hawai'i-based residential solar company. I was previously a partner in Suntech Hawaii, which grew its sales from $3 to $30 million in the year I spent at the company. In 2009, I was named Hawai'i Venture Capital Association's Cleantech Entrepreneur of the Year and one of Pacific Business News's "40 Under 40" young business leaders; and in December 2009, I received the Governor of the State of Hawai'i's Innovation Award in recognition of my contributions to the State's renewable energy industry. I am the President of the Hawai'i Solar Energy Association ("HSEA"), a Member of the Hawai'i Energy Policy Forum and Co-Chair of its Renewable Energy Working Group, a Board Member of the Hawai'i PV Coalition, a Member of the Steering Committee for Energy Efficiency of the Hawai'i Clean Energy Initiative, and member of the Hawai'i Department of Labor and Industrial Relation's Steering Committee for Renewable Energy Workforce Development.

2. My profession involves working in the Hawai'i solar energy market on a daily basis. I have participated in the development of dozens of solar energy projects from start to finish throughout the Hawaiian Islands, ranging from residential rooftops to the largest roof-mounted photovoltaic ("PV") project in the state and the second largest ground mounted project in the state. I have first-hand understanding of what it takes for PV projects to work in the Hawai'i market. My role as HSEA President also provides me with a direct, continual source of insight and updates on the Hawai'i solar industry and market. HSEA's membership includes installers, distributers, manufacturers, and financers of solar energy systems, most of which are Hawai'i based, owned and operated. HSEA members install the majority of solar systems in the Hawaiian Islands. We have decades of collective experience specifically in the Hawai'i solar energy market and are uniquely and intimately familiar with how this market works. In short, we are the companies actually implementing the projects the FIT seeks to promote, and who must work with the real-world ramifications of the decisions in this docket.

3. I provide this declaration to address several important points regarding the Hawaiian Electric ("HECO Companies") filings regarding reliability standards by Hawaiian Electric Company, Inc. ("HECO"), Hawaii Electric Light Company, Inc. ("HELCO"), and Maui Electric Company, Ltd. ("MECO") (collectively, the "HECO Companies").

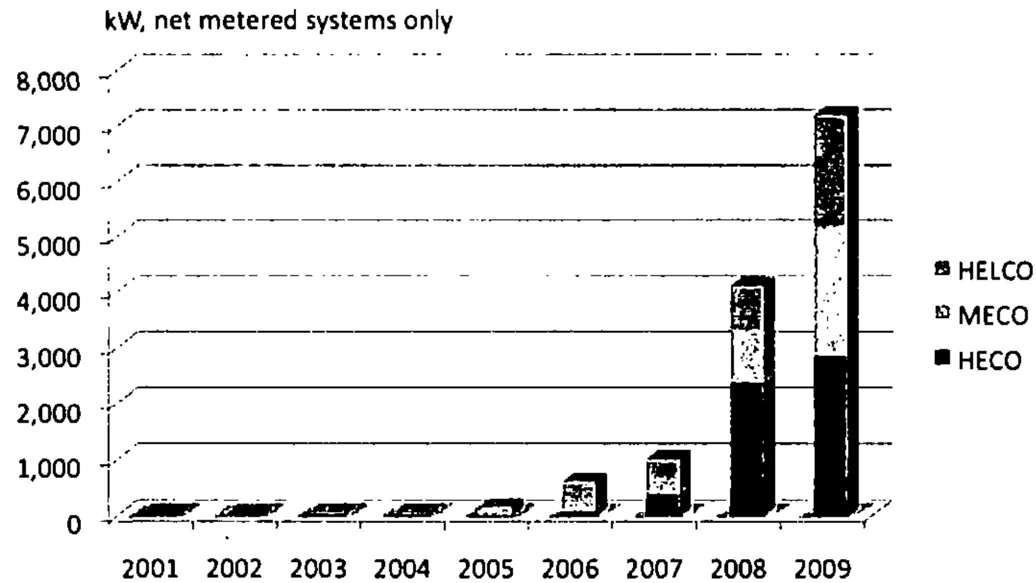
Impacts of the HECO Companies' Proposed Limits on Renewable Distributed Generation

4. In my role as HSEA President, I am well positioned to understand the impact that a hard cap, moratorium or other interruption in the market for distributed PV systems will have on Hawai'i's solar industry. In short, this impact would be rapid, disastrous, and pervasive. I briefly explain why below.

5. Currently, Hawai'i is one of only a handful of U.S. states with a viable market for distributed PV. This results from the combined effect of federal incentives, state incentives, and energy cost offsets that succeed in making PV an "in the money" investment for Hawai'i homeowners and business owners. The resulting demand for installation of PV systems, along with education provided by the solar industry to potential clients, is what has created the market in our state.

6. This market has grown steadily from a very low base since around 2001, spurred by the introduction of net energy metering ("NEM"), see Figure below. Note that despite the MECO and HELCO systems being smaller than the HECO system, 2009 installations were roughly equal across all three companies.

Net Metered PV on the HECO/MECO/HELCO Systems



Source: HECO Companies Net Energy Metering Annual Status Report 2009

7. Currently, the program cap on NEM is at three percent of system peak load for MECO and HELCO and one percent for HECO. As part of the stipulation that raised the cap from one to three percent on the MECO and HELCO grids, the HECO Companies and Consumer Advocate proposed, and the Commission approved and ordered, an automatic increase to four percent once one of a number of triggers are met. The HECO Companies typically do not make public data that allow the calculation of the exact state of NEM penetration relative to the cap-increase triggers. MECO has recently revealed that it is nearing the three percent cap. We are unsure where the HELCO system is relative to its cap-raising triggers, but estimate that it will reach the three percent cap sometime later this year.

8. The HECO Companies propose limiting NEM to three percent on the MECO and HELCO grids while their proposed Working Group studies reliability issues over a timetable that stretches until the end of June 2011. The HECO Companies also maintain their opposition to allowing the FIT program to proceed for MECO and HELCO. Without access to NEM or FIT, the Hawai'i-based solar industry on these islands will rapidly collapse (even if several one-off transmission level projects may be contracted and/or constructed during this time).

9. (I note, however, that the day prior to this filing, MECO has submitted a letter notifying the Commission of its intent to move to four percent. This change appears to be in response to repeated questioning by one of HSEA's members about the penetration percentage on the MECO system, which revealed that it was at or near 90 percent, notwithstanding that 75 percent was the cap-increase trigger ordered by the Commission.)

10. Hawai'i-based companies have developed the overwhelming share of the projects represented in the previous Figure. Because of the rapid growth of the demand for PV, Hawai'i-based companies have had to invest and build capacity in their businesses to keep up. This investment cycle means that increased revenues do not translate into increased profitability. Instead, Hawai'i's companies have reinvested their earnings, which means that they do not have cash and/or credit cushions that would allow them to pay workers and meet overhead demands if business is interrupted. In short, these companies have been led into a position vulnerable to

business interruptions by the state's movement towards more renewable energy, and an interruption in this movement will leave them "high and dry."

11. Such an interruption will have far-reaching impacts not only on the industry, but the state as a whole. The growth of the solar industry has had a number of important spillover benefits for the state, including job growth, construction spending, and customer savings, and fewer dollars exported outside the state to pay for petroleum. In fact, distributed PV is an engine of economic growth for Hawai'i at several levels. At the most macro level, the reduction in the need to purchase fuel to produce power keeps additional resources flowing within Hawai'i's economy. Although has PV has not yet seriously dented the state's $6-7 billion annual oil bill, it is steadily eating away at it.

12. At a micro-economic level, businesses use solar power to reduce and hedge a key component of operating costs. A business owner that no longer has to worry about the cost of power has funds available to reinvest in his/her business, thus further stimulating Hawaii's economy. The same is true of homeowners, who have additional discretionary income to spend locally if they are freed from the need to buy ever more costly grid power each month. These spillovers are one of the most important advantages for the state of the move to distributed PV for more of its generation and will be lost if the portion of the solar industry focused on distributed generation is forced to shut down.

13. Although precise data on the size of the overall solar market in Hawai'i have not been developed, some clues exist. One of the few concrete data points

available is the dollar volume of PV permits pulled on O'ahu in 2009, which was $118 million, up from $85 million in 2008 (note that this does not include the roughly $60 million in solar water heating systems installed on O'ahu). At this rate, using the State's macroeconomic modeling factors, the solar industry is responsible for more than 1,330 jobs on O'ahu alone. Given that installations occur disproportionately on the neighbor islands, the estimated total job count associated with the Hawai'i-based PV industry is approximately 2,000. An informal survey of HSEA members conducted in December 2009 arrived at a similar figure.

14. In conclusion, putting DG on hold on the MECO and HELCO systems or slowing it down on the HECO system will have a number of immediate negative consequences for Hawai'i-based contractors, as well as for Hawai'i's homeowners and business owners. These include job losses and business failures in the solar industry, decreased consumer choice and increased expenses for other business owners and for homeowners, as well as continued vulnerability of the state to fluctuations in global oil markets.

Background on Reliability Standards Technical Sessions

15. I attended both "Technical Sessions" on reliability standards the HECO Companies held on November 20, 2009 and January 26, 2010. Both these meetings consisted of the HECO Companies presenting lengthy powerpoints, with limited opportunity for the parties to offer their on-the-spot reactions. These meetings did not foster collaboration or incorporate the intervenor parties in the process of developing reliability standards.

16. In the November 20, 2009 meeting, the HECO Companies presented a powerpoint reviewing general concepts. The presentation referred to "cap" and "non-cap" options, and also used the term "target." The presentation provided no specific figures or analysis, or other concrete proposals. Parties raised concerns that the HECO Companies would seek to redraw the FIT system caps the Commission established in its D&O, but the HECO Companies insisted they would not.

17. In mid-January 2010, intervenor parties inquired whether the HECO Companies would hold a follow-up session as provided by the Commission's adopted procedural schedule. The HECO Companies then scheduled and held the second meeting on January 26, 2010. The meeting involved another powerpoint presentation, which reviewed general information on the levels of distributed generation ("DG") penetration of the HECO Companies' grids. Again, the presentation alternated between the terms "cap" and "target," and the parties received conflicting messages on this issue, including an assurance by the HECO Companies in response to parties' concerns that they were not proposing actual "caps."

18. Almost all of the material in the HECO Companies' 125-page reliability standards report was never seen by the parties prior to its filing. The parties learned of the HECO Companies' proposed limits on DG by reading the filing.

<u>Background on PV System Frequency Trip Setting Issue</u>

19. In my work for HSEA as well as my own businesses, I am well familiar with the issue of the frequency trip settings for PV system inverters that the HECO Companies raise in their filings. To the best of my knowledge this issue first came

publicly to light at a MECO integrated resource planning ("IRP") meeting in 2008 following a single wind ramping induced event on MECO's Maui grid that caused a number of inverter-based systems to trip off. MECO characterized the underfrequency inverter tripping issue as a concern that called into question the wisdom of interconnecting additional grid-tied PV systems at the distribution level. We in the solar industry, including me, recognized the underfrequency excursions causing inverter tripping as a legitimate concern and came back with the suggestion that the HECO Companies lower the required underfrequency trip settings, ideally to levels below the load shedding trigger levels, in order to convert inverter-based PV into a resource providing frequency support.

20. After establishing the technological viability of this solution, the solar industry began advocating for it in various forums in which the HECO Companies continued displaying a graphic showing the same single event in which the Kaheawa wind project suddenly stopped producing power and MECO was unable to increase generation quickly enough to maintain the frequency within a narrow enough band to prevent frequency excursions outside the 59.3 Hz trip point on the PV inverters. Interestingly, it was HELCO not MECO that first adopted (in late 2008) the lower underfrequency trip setting as a requirement for interconnecting to its grid. In 2010 MECO has followed suit with a similar requirement. The HECO Companies now cite this solution in their February 8, 2010 filing as a main example of the proactive steps they are taking to accommodate further renewable DG.

21. The HECO Companies, however, still continue to raise the frequency trip setting issue as support for their proposed limits on renewable DG, noting that some existing systems on the all grids still remain at 59.3 Hz. This concern is misplaced for several basic reasons. First, the trip settings on all new PV system inverters can be set or reset to 57 Hz, so there is no reason why any new systems should contribute to any problem. Second, to the extent the inverters on older systems that cannot be reset are interconnected to the utility grid, these earlier generation inverters have a limited lifespan of around 10 years and in many cases are reaching the end of their lives. Upon failure and replacement of these inverters, the trip settings for these systems can be changed. Thus, the body of existing PV systems set at 59.3 Hz is a finite amount that can only decrease over time as the pool of old inverters turn over and, in any event, is not large enough to justify the installation of new PV systems set at 57 Hz going forward.

HECO Companies' Service Reliability Reports

22. Attached hereto as Exhibits 7 and 8 are true and correct copies of the 2008 Annual Service Reliability Reports filed with this Commission for the HELCO and MECO systems, respectively. These reports document tens of thousands of customer interruptions and interruption hours, from causes ranging from failure in equipment and operation, trees and branches, auto accidents, and deterioration, but does not attribute a single incident to renewable energy systems.

Dated: March 23, 2010, at Honolulu, Hawai'i.

MARK DUDA

EXHIBIT 7

Hawaii Electric Light Company, Inc. • PO Box 1027 • Hilo, HI 96721-1027

G. File
C: Sec
Shds

Jay M. Ignacio, P.E.
President

May 7, 2009

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PUBLIC UTILITIES
COMMISSION

The Honorable Chairman and Members of the
Hawaii Public Utilities Commission
Kekuanaoa Building
465 South King Street, First Floor
Honolulu, Hawaii 96813

Dear Commissioners:

Subject: HELCO 2008 Annual Service Reliability Report

Hawaii Electric Light Company, Inc. respectfully submits a copy of its 2008 Annual Service Reliability Report.

Sincerely,

Attachment

c: Division of Consumer Advocacy (with Attachment)

EXHIBIT 7

Hawaii Electric Light Co., Inc.

ANNUAL SERVICE RELIABILITY REPORT

2008

Prepared By:

Kevin Waltjen
Manager
Distribution Department

April 16, 2009

CONTENTS

INTRODUCTION

The 2008 service reliability indices and the system reliability indices for the past five years are provided to depict HELCO's quality of service. A summary of 2008 system reliability data is provided in the subsequent sections. Definitions of terms and descriptions of the reliability indices are attached in Appendices A and B. Reliability data are presented in tables and graphs contained in Appendices C through E.

SUMMARY OF 2008 RELIABILITY DATA

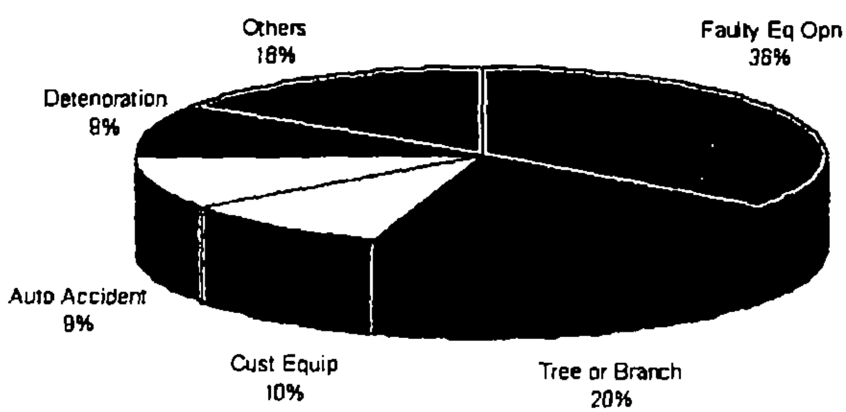
The average customer count increased 1.9% from 77,933 in 2007 to 79,386 in 2008.

On a Not-Normalized basis, in 2008 a total of 194,807 Customer Interruptions were recorded for a total of 190,314 Customer Hours of Interruption. The System Average Interruption Frequency (SAIF) index was 2.454 and the Customer Average Interruption Duration (CAID) was 58.62 minutes.

On the Normalized basis, a total of 179,862 Customer Interruptions were recorded for a total of 189,156 Customer Hours of Interruptions. The System Average Interruption Frequency (SAIF) index was 2.266 and the Customer Average Interruption Duration (CAID) was 63.10 minutes.

On a Not-Normalized basis, the following were the leading causes of customer interruptions in 2007:

1. **Faulty Equipment Operation.** There were 68,574 Customer Interruptions, 66,538 (97%) of those were related to HELCO Generation.
2. **Trees and Branches.** There were 38,497 Customer Interruptions.
3. **Failure of Customer Equipment.** There were 19,762 Customer Interruptions, 19,752 (nearly 100%) of those were related to Independent Power Producers (non-HELCO Generation).
4. **Auto Accident.** There were 18,475 Customer Interruptions.
5. **Deterioration.** There were 18,045 Customer Interruptions.



There were 86,290 generation related Customer Interruptions in 2008, of which 66,538 were related to HELCO Generation sources (77%) and 19,752 were related to Independent Power Producers (non-HELCO Generation) sources (23%). In 2008 Hamakua Energy Partners (HEP) was the only non-HELCO generation sources that caused customer interruptions.

In 2008 HELCO normalized data per guidelines specified in a special report on reliability prepared for the Public Utilities Commission. This report, "Methodology for Determining Reliability Indices for HECO Utilities", dated December 1990, indicates that *normalization may be utilized for "abnormal" situations such as hurricanes, tsunamis,* earthquakes, floods, catastrophic equipment failures, and a single equipment outage that cascades into a loss of load that is greater than 10% of the system peak load. HELCO normalized one event in 2008:

- Underfrequency Loadshedding event on July 2 due to Hamakua Energy Partners (HEP) tripping off-line while exporting 29.6 MW resulted in 14,945 Customer Interruptions and 1,311 Customer Hours of Interruption.

Significant interruptions, contributing more than 5,000 Customer Interruptions (CI) or Customer Interruption Duration (CID) greater than 5,000 Customer Hours of Interruption that did not meet the normalization criteria were:

Date	Problem	CI	CID
January 7	Underfrequency loadshedding – Hill 6 Steam tripped off-line	6,969	410
January 30	Auto Accident long Hwy 11 In Kurtistown area affecting 34.5kV transmission line	5,190	4,336
April 24	Underfrequency loadshedding – Hill 6 Steam tripped off-line	9,606	668
April 29	Underfrequency loadshedding – Hill 6 Steam tripped off-line	6,465	261
May 8	Tree contacting 69kV transmission line in South Kona	4,046	5,672
May 18	Tree falling on distribution lines in Hawaiian Beaches area	2,251	5,224
July 31	Underfrequency loadshedding – Hill 6 Steam tripped off-line	12,994	1,259

Date	Problem	CI	CID
August 1	Underfrequency loadshedding – Hill 6 Steam tripped off-line	12,994	593.87
August 16	Auto Accident in Kailua-Kona affecting distribution lines	1,160	5,551
August 31	Forced maintenance affecting customers in Upper Puna to allow emergency replacement of substation transformer	4,245	42,875
October 15	Underfrequency loadshedding – Keahole CT-4 tripped off-line	9,670	330
November 24	Tree falling across 34.5kV transmission lines affecting North Kohala	1,920	6655
December 30	Tree falling across 69kV transmission lines affecting parts of Lower Puna and portion of Hilo area	8,960	5,471

APPENDIX A
DEFINITION OF TERMS

OUTAGE
The state of component when it is not available to perform its intended function due to some event directly associated with that component. An outage may or may not cause an interruption of service to customers depending on system configuration.

INTERRUPTION
The loss of service to one or more customers and is a result of one or more component outages.

INTERRUPTION DURATION
The period from the initiation of an interruption to a customer until service has been restored to that customer.

MOMENTARY INTERRUPTION
An interruption that has a duration limited to the period required to restore service by automatic or supervisory-controlled switching operations or by manual switching at locations where an operator is immediately available. Such switching operations must be completed in a specific time not to exceed one minute. Previous issues of this report indicated that a momentary interruption has a duration not to exceed five minutes. A December 1990 report "Methodology for Determining Reliability Indices of HELCO" indicated that momentary interruptions will have a duration less than one minute.

SUSTAINED INTERRUPTION
Any interruption not classified as a momentary interruption. Only this type of interruption is included in the reliability indices which follow. In conformance with the guidelines established in the report, "Methodology for Determining Reliability Indices for HELCO", dated December 1990, a sustained interruption has a duration of one minute or longer.

CUSTOMER INTERRUPTION
One interruption of one customer. NOTE: Interruption to customers at their request (e.g., customer maintenance) is not considered.

APPENDIX B
RELIABILITY INDICES

Reliability indices used in this report conform to standards proposed by both the Edison Electric Institute (EEI) and the Institute of Electrical and Electronics Engineers (IEEE) unless otherwise indicated in the above definitions. Three reliability indices that convey a meaningful representation of the level of reliability were selected and are presented in this report. These reliability indices are as follows:

AVERAGE SERVICE AVAILABILITY INDEX (ASA)
Total customer hours actually served as a percentage of total customer hours possible during the year. This indicates the extent to which electrical service was available to all customers. This index has been commonly referred to as the "Index of Reliability." A customer-hour is calculated by multiplying the number of customers who are affected by the length of time they are affected.

SYSTEM AVERAGE INTERRUPTION FREQUENCY INDEX (SAIF)
The number of customer interruptions per customer served during the year. This index indicates the average number of interruptions experienced by all customers serviced on the system.

CUSTOMER AVERAGE INTERRUPTION DURATION INDEX (CAID)
The interruption duration per customer interrupted during the year. This index indicates the average duration of an interruption for those customers affected by a sustained interruption.

These three reliability indices give a good indication of how reliable the electrical service is to the customer:

1. Is electrical service available most of the time (ASA).
2. How often an outage occurs (SAIF).
3. How long the outage might last (CAID).

The average number of customers on the system for the year is used for the value of number of customers served during the year and only sustained interruptions are considered.

APPENDIX C
ALL CAUSES
2003-2008 Annual Service Reliability Indices

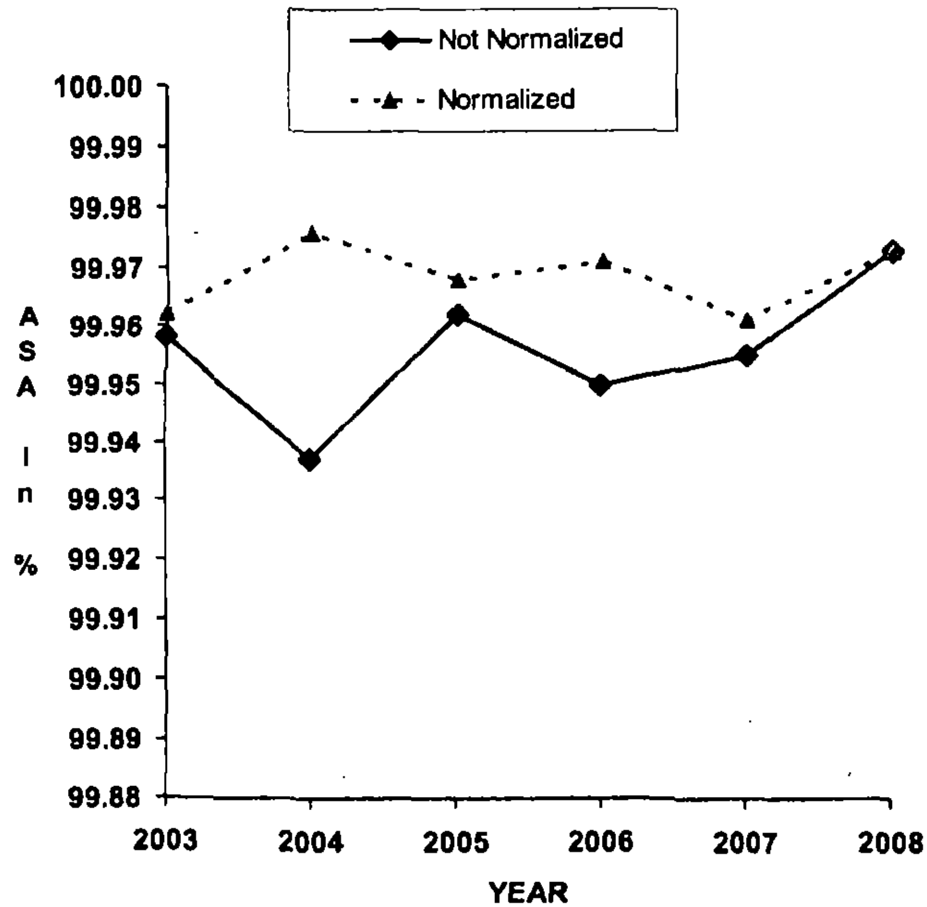
Normalized

Year	ASA	Number of Customers	Customer Interruptions	CID	SAIF	CAID
2003	99.962	67,879	213,873	225,439	3.151	63.24
2004	99.976	70,124	163,745	150,905	2.335	55.30
2005	99.968	72,513	153,982	200,374	2.124	78.08
2006	99.971	75,353	188,602	190,061	2.503	60.46
2007	99.961	77,933	208,000	269,475	2.669	77.73
2008	99.973	79,386	179,862	189,156	2.266	63.10

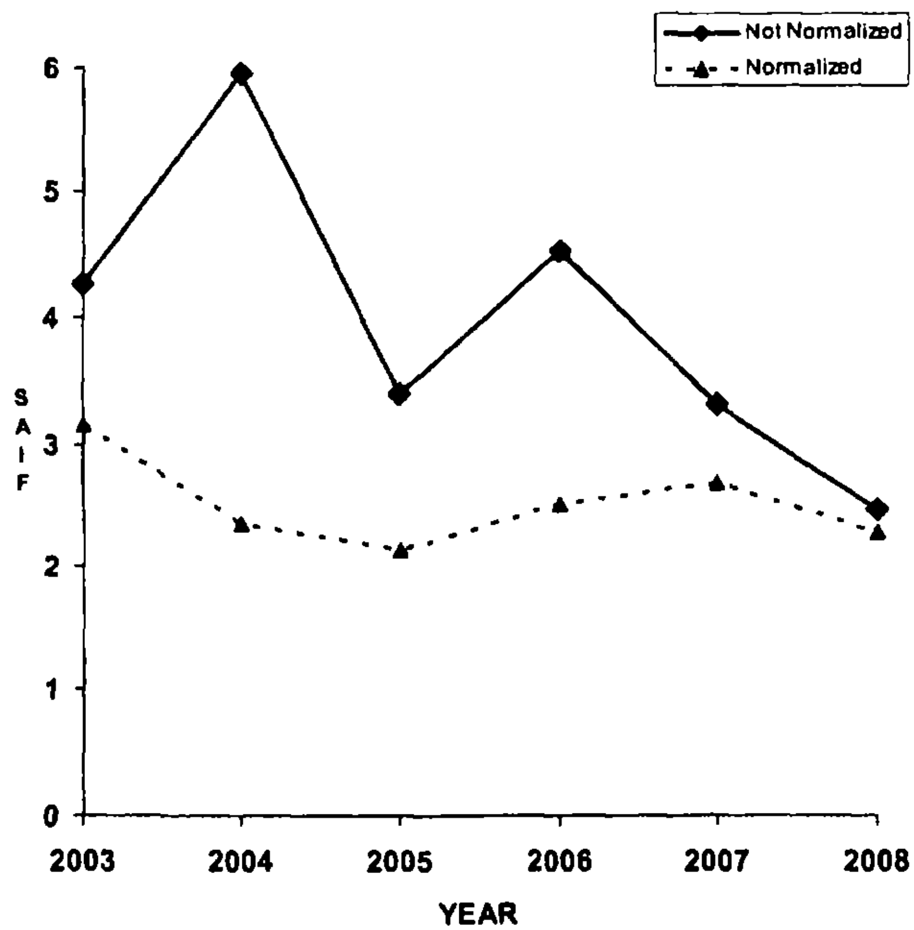
Not-Normalized

Year	ASA	Number of Customers	Customer Interruptions	CID	SAIF	CAID
2003	99.958	67,879	289,027	251,280	4.258	52.16
2004	99.937	70,124	417,462	388,891	5.953	55.89
2005	99.962	72,513	246,557	239,935	3.400	58.39
2006	99.95	75,353	341,289	328,758	4.529	57.80
2007	99.955	77,933	257,924	305,681	3.310	71.11
2008	99.973	79,386	194,807	190,314	2.454	58.62

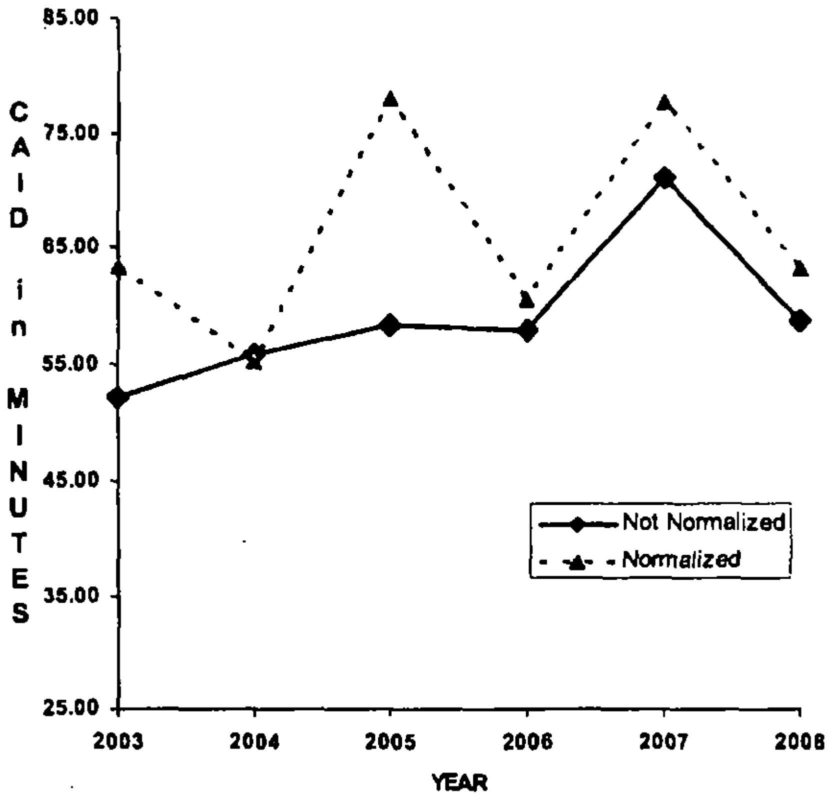
AVERAGE SERVICE AVAILABILITY INDEX
(ASA IN %)



SYSTEM AVERAGE INTERRUPTION FREQUENCY
(SAIF)



CUSTOMER AVERAGE INTERRUPTION DURATION
(CAID)



2008
SERVICE RELIABILITY SUMMARY
Normalized

Cause of Outage	CUST-HR	CUST-INT	SAIF	SAID	CAID	SAID RANK
Faulty Equip Opn	3810.7	68574	0.864	2.88	3.33	8
Tree or Branches	55770.4	38497	0.485	42.15	86.92	1
Auto Accident	28903.5	18475	0.233	21.85	93.87	3
Deterioration	23625.0	18045	0.227	17.86	78.55	4
Tsf Failure	4639.0	10172	0.128	3.51	27.36	6
Cable Fault	13827.4	6931	0.087	10.45	119.70	5
Forced Maint	44115.2	5708	0.072	33.34	463.72	2
Customer Equip	442.1	4817	0.061	0.33	5.51	14
Scheduled Maint	4045.7	1690	0.021	3.06	143.63	7
Equip Failure	3183.4	1625	0.020	2.41	117.54	9
Unknown	1779.7	1526	0.019	1.35	69.97	11
Foreign Objects	935.0	1008	0.013	0.71	55.65	12
Excavate Constr	619.6	936	0.012	0.47	39.72	13
Lightning	2554.6	834	0.011	1.93	183.79	10
Other Persnl Err	272.0	542	0.007	0.21	30.11	15
Man or Animal	266.3	214	0.003	0.20	74.67	16
Balance Load	42.6	146	0.002	0.03	17.52	19
Loose Connection	104.3	31	0.000	0.08	201.94	17
Sys Add/Removal	18.9	30	0.000	0.01	37.83	22
Fire	32.8	17	0.000	0.02	115.76	20
Balloon/Kite	10.2	14	0.000	0.01	43.57	26
High Wind	14.9	8	0.000	0.01	112.00	24
Equip Overload	17.8	7	0.000	0.01	152.71	23
Equip Contact	28.5	5	0.000	0.02	341.40	21
Flood / Tsunami	71.7	4	0.000	0.05	1075.50	18
Vandalism	4.3	2	0.000	0.00	128.00	28
Flashover	11.2	2	0.000	0.01	336.00	25
Tsf Overload	6.5	1	0.000	0.00	390.00	27
Transfer Load	2.3	1	0.000	0.00	137.00	29
Customer Maint	0.0	0	0.000	0.00	0.00	31
Opn or Sw Error	0.0	0	0.000	0.00	0.00	30
TOTALS:	189155.5	179862	2.266	142.96	63.10	

NUMBER OF CUSTOMERS FOR THE PERIOD = 79386 ASA = 99.973%

SAIF = SYSTEM AVERAGE INTERRUPTION FREQUENCY

SAID = SYSTEM AVERAGE INTERRUPTION DURATION (MINUTES)

CAID = CUSTOMER AVERAGE INTERRUPTION DURATION

THE OUTAGE CAUSES ARE LISTED IN ORDER OF ITS SAIF

2008
SERVICE RELIABILITY SUMMARY
Not-Normalized

Cause of Outage	CUST-HR	CUST-INT	SAIF	SAID	CAID	SAID RANK
Faulty Equip Opn	3810.7	68574	0.864	2.88	3.33	8
Tree or Branches	55770.4	38497	0.485	42.15	86.92	1
Customer Equip	1600.3	19762	0.249	1.21	4.86	12
Auto Accident	28903.5	18475	0.233	21.85	93.87	3
Deterioration	23625.0	18045	0.227	17.86	78.55	4
Tsf Failure	4639.0	10172	0.128	3.51	27.36	6
Cable Fault	13827.4	6931	0.087	10.45	119.70	5
Forced Maint	44115.2	5708	0.072	33.34	463.72	2
Scheduled Maint	4045.7	1690	0.021	3.06	143.63	7
Equip Failure	3183.4	1625	0.020	2.41	117.54	9
Unknown	1779.7	1526	0.019	1.35	69.97	11
Foreign Objects	935.0	1008	0.013	0.71	55.65	13
Excavate Constr	619.6	936	0.012	0.47	39.72	14
Lightning	2554.6	834	0.011	1.93	183.79	10
Other Persnl Err	272.0	542	0.007	0.21	30.11	15
Man or Animal	266.3	214	0.003	0.20	74.67	16
Balance Load	42.6	146	0.002	0.03	17.52	19
Loose Connection	104.3	31	0.000	0.08	201.94	17
Sys Add/Removal	18.9	30	0.000	0.01	37.83	22
Fire	32.8	17	0.000	0.02	115.76	20
Balloon/Kite	10.2	14	0.000	0.01	43.57	26
High Wind	14.9	8	0.000	0.01	112.00	24
Equip Overload	17.8	7	0.000	0.01	152.71	23
Equip Contact	28.5	5	0.000	0.02	341.40	21
Flood / Tsunami	71.7	4	0.000	0.05	1075.50	18
Vandalism	4.3	2	0.000	0.00	128.00	28
Flashover	11.2	2	0.000	0.01	336.00	25
Tsf Overload	6.5	1	0.000	0.00	390.00	27
Transfer Load	2.3	1	0.000	0.00	137.00	29
Customer Maint	0.0	0	0.000	0.00	0.00	31
Opn or Sw Error	0.0	0	0.000	0.00	0.00	30
TOTALS:	190313.7	194807	2.454	143.84	58.62	

NUMBER OF CUSTOMERS FOR THE PERIOD = 79386 ASA = 99.973%

SAIF = SYSTEM AVERAGE INTERRUPTION FREQUENCY

SAID = SYSTEM AVERAGE INTERRUPTION DURATION (MINUTES)

CAID = CUSTOMER AVERAGE INTERRUPTION DURATION

THE OUTAGE CAUSES ARE LISTED IN ORDER OF ITS SAIF

2008
SYSTEM INTERRUPTION CAUSE REPORT
Not-Normalized

CAUSE		# of Interruptions		Customer Hours	
NON-CONNECTED SYSTEM EMERGENCY	(Totals)	**345**	**31.14%**	**88287.5**	**46.39%**
Tree or Branches		241	21.75%	55770.4	29.30%
Auto Accident		45	4.06%	28903.5	15.19%
Man or Animal		18	1.62%	266.3	0.14%
Excavate Constr		12	1.08%	619.6	0.33%
Customer Equip		6	0.54%	1600.3	0.84%
Foreign Objects		6	0.54%	935.0	0.49%
Balance Load		5	0.45%	42.6	0.02%
Fire		3	0.27%	32.8	0.02%
Equip Contact		2	0.18%	28.5	0.01%
Balloon/Kite		2	0.18%	10.2	0.01%
Vandalism		2	0.18%	4.3	0.00%
Flood/Tsunami		2	0.18%	71.7	0.04%
Transfer Load		1	0.09%	2.3	0.00%
ERROR	(Totals)	**17**	**1.53%**	**272.0**	**0.14%**
Other Personl Err		17	1.53%	272.0	0.14%
Opn or Sw Error		0	0.00%	0.0	0.00%
WEATHER	(Totals)	**75**	**6.77%**	**2569.5**	**1.35%**
Lightning		74	6.68%	2554.6	1.34%
High Wind		1	0.09%	14.9	0.01%
EQUIPMENT FAILURE	(Totals)	**167**	**15.07%**	**44579.8**	**23.42%**
Deterioration		98	8.84%	23625.0	12.41%
Cable Fault		49	4.42%	13827.4	7.27%
Faulty Equip Opn		10	0.90%	3810.7	2.00%
Equip Failure		4	0.36%	3183.4	1.67%
Flashover		2	0.18%	11.2	0.01%
Equip Overload		2	0.18%	17.8	0.01%
Loose Connection		2	0.18%	104.3	0.05%
TRANSFORMER FAILURE	(Totals)	**60**	**5.42%**	**4645.5**	**2.44%**
Tsf Failure		59	5.32%	4639.0	2.44%
Tsf Overload		1	0.09%	6.5	0.00%
UNKNOWN AFTER TESTS AND INSPECTIONS	(Totals)	**73**	**6.59%**	**1779.7**	**0.94%**
Unknown		73	6.59%	1779.7	0.94%
MAINTENANCE	(Totals)	**363**	**32.76%**	**48160.9**	**25.31%**
Scheduled Maint		185	16.70%	4045.7	2.13%
Forced Maint		178	16.06%	44115.2	23.18%
SYSTEM ADDITIONS OR REMOVALS	(Totals)	**8**	**0.72%**	**18.9**	**0.01%**
Sys Add/Removal		8	0.72%	18.9	0.01%
	Totals	**1108**		**190313.8**	

APPENDIX D
T&D vs GENERATION
2003-2008 Service Reliability Indices
Not-Normalized

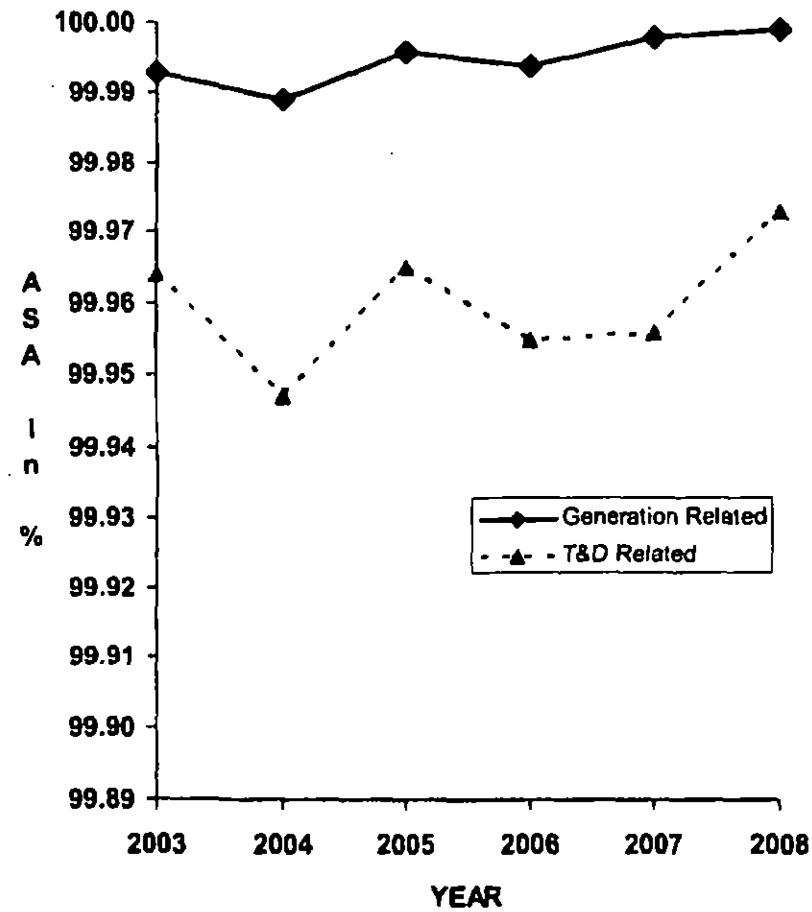
T&D Related Outages Only

Year	ASA	Number of Customers	Customer Interruptions	CID	SAIF	CAID
2003	99.964	67,879	178,347	213,252	2.627	71.74
2004	99.947	70,124	186,792	322,510	2.664	103.59
2005	99.965	72,513	140,092	219,045	1.932	93.81
2006	99.955	75,353	175,438	292,048	2.328	99.88
2007	99.956	77,933	165,461	294,463	2.123	106.78
2008	99.973	79,386	108,517	185,015	1.367	102.30

Generation Related Outages Only

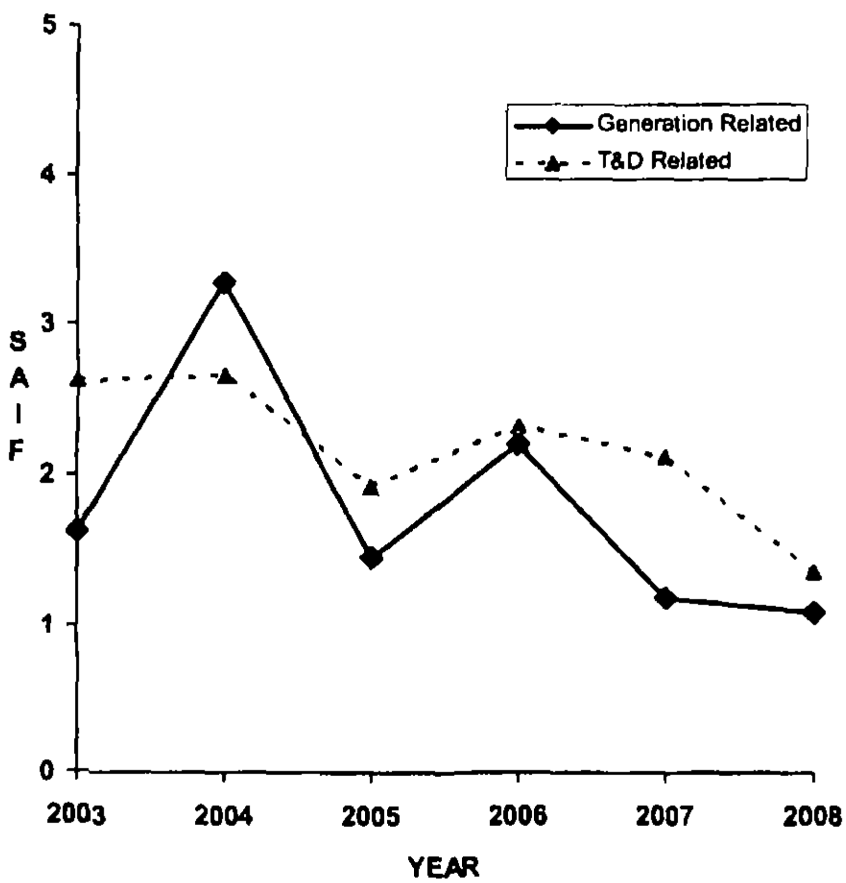
Year	ASA	Number of Customers	Customer Interruptions	CID	SAIF	CAID
2003	99.993	67,879	110,669	37,751	1.63	33.37
2004	99.989	70,124	230,670	66,381	3.289	17.27
2005	99.996	72,513	106,465	20,890	1.468	11.77
2006	99.994	75,353	165,851	36,710	2.201	13.28
2007	99.998	77,933	92,463	11,218	1.186	7.28
2008	99.999	79,386	86,290	5,299	1.087	3.68

T&D vs. GENERATION
AVERAGE SERVICE AVAILABILITY INDEX
(ASA IN %)
Not-Normalized

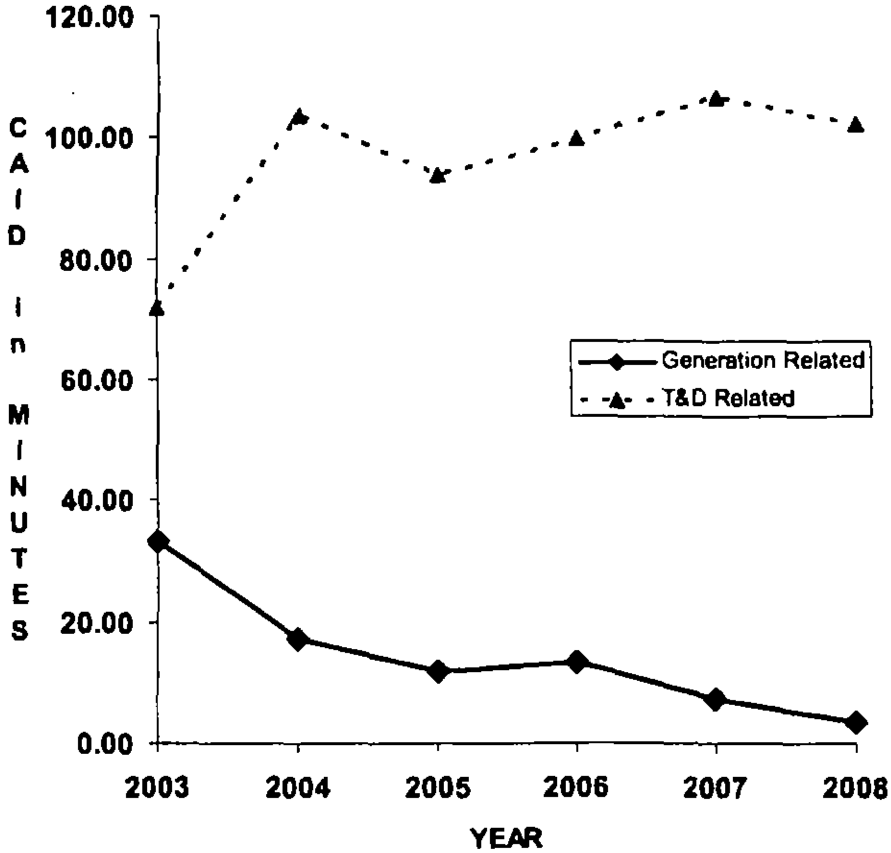


SYSTEM AVERAGE INTERRUPTION FREQUENCY (SAIF)

Not-Normalized



CUSTOMER AVERAGE INTERRUPTION DURATION (CAID)
Not-Normalized



2008
T&D SERVICE RELIABILITY SUMMARY
Not-Normalized

Cause of Outage	CUST-HR	CUST-INT	SAIF	SAID	CAID	SAID RANK
Tree or Branches	55770.4	38497	0.485	42.15	86.92	1
Auto Accident	28903.5	18475	0.233	21.85	93.87	3
Deterioration	23625.0	18045	0.227	17.86	78.55	4
Tsf Failure	4639.0	10172	0.128	3.51	27.36	6
Cable Fault	13827.4	6931	0.087	10.45	119.70	5
Forced Maint	44115.2	5708	0.072	33.34	463.72	2
Faulty Equip Opn	102.1	2036	0.026	0.08	3.01	16
Scheduled Maint	4045.7	1690	0.021	3.06	143.63	7
Equip Failure	3183.4	1625	0.020	2.41	117.54	8
Unknown	1779.7	1526	0.019	1.35	69.97	10
Foreign Objects	935.0	1008	0.013	0.71	55.65	11
Excavate Constr	619.6	936	0.012	0.47	39.72	12
Lightning	2554.6	834	0.011	1.93	183.79	9
Other Persnl Err	272.0	542	0.007	0.21	30.11	13
Man or Animal	266.3	214	0.003	0.20	74.67	14
Balance Load	42.6	146	0.002	0.03	17.52	18
Loose Connection	104.3	31	0.000	0.08	201.94	15
Sys Add/Removal	18.9	30	0.000	0.01	37.83	21
Fire	32.8	17	0.000	0.02	115.76	19
Balloon/Kite	10.2	14	0.000	0.01	43.57	25
Customer Equip	9.9	10	0.000	0.01	59.50	26
High Wind	14.9	8	0.000	0.01	112.00	23
Equip Overload	17.8	7	0.000	0.01	152.71	22
Equip Contact	28.5	5	0.000	0.02	341.40	20
Flood / Tsunami	71.7	4	0.000	0.05	1075.50	17
Flashover	11.2	2	0.000	0.01	336.00	24
Vandalism	4.3	2	0.000	0.00	128.00	28
Tsf Overload	6.5	1	0.000	0.00	390.00	27
Transfer Load	2.3	1	0.000	0.00	137.00	29
Customer Maint	0.0	0	0.000	0.00	0.00	31
Opn or Sw Error	0.0	0	0.000	0.00	0.00	30
TOTALS:	185014.7	108517	1.367	139.83	102.30	

NUMBER OF CUSTOMERS FOR THE PERIOD = 79386 % ASA = 99.973

SAIF = SYSTEM AVERAGE INTERRUPTION FREQUENCY

SAID = SYSTEM AVERAGE INTERRUPTION DURATION (MINUTES)

CAID = CUSTOMER AVERAGE INTERRUPTION DURATION

THE OUTAGE CAUSES ARE LISTED IN ORDER OF ITS SAIF

2008
GENERATION SERVICE RELIABILITY SUMMARY
Not-Normalized

Cause of Outage	CUST-HR	CUST-INT	SAIF	SAID	CAID	SAID RANK
Faulty Equip Opn	3708.6	66538	0.838	2.80	3.34	1
Customer Equip	1590.4	19752	0.249	1.20	4.83	2
Man or Animal	0.0	0	0.000	0.00	0.00	17
Tsf Overload	0.0	0	0.000	0.00	0.00	3
Equip Failure	0.0	0	0.000	0.00	0.00	4
Balloon/Kite	0.0	0	0.000	0.00	0.00	5
Other Persnl Err	0.0	0	0.000	0.00	0.00	6
Unknown	0.0	0	0.000	0.00	0.00	7
Customer Maint	0.0	0	0.000	0.00	0.00	8
Sys Add/Removal	0.0	0	0.000	0.00	0.00	9
Forced Maint	0.0	0	0.000	0.00	0.00	10
Scheduled Maint	0.0	0	0.000	0.00	0.00	11
Balance Load	0.0	0	0.000	0.00	0.00	12
Transfer Load	0.0	0	0.000	0.00	0.00	13
Flood / Tsunami	0.0	0	0.000	0.00	0.00	14
Deterioration	0.0	0	0.000	0.00	0.00	23
Auto Accident	0.0	0	0.000	0.00	0.00	30
Tsf Failure	0.0	0	0.000	0.00	0.00	29
Cable Fault	0.0	0	0.000	0.00	0.00	28
Flashover	0.0	0	0.000	0.00	0.00	27
Loose Connection	0.0	0	0.000	0.00	0.00	26
Opn or Sw Error	0.0	0	0.000	0.00	0.00	15
Equip Overload	0.0	0	0.000	0.00	0.00	24
Lightning	0.0	0	0.000	0.00	0.00	16
Vandalism	0.0	0	0.000	0.00	0.00	22
Excavate Constr	0.0	0	0.000	0.00	0.00	21
Equip Contact	0.0	0	0.000	0.00	0.00	20
Fire	0.0	0	0.000	0.00	0.00	19
Foreign Objects	0.0	0	0.000	0.00	0.00	18
Tree or Branches	0.0	0	0.000	0.00	0.00	31
High Wind	0.0	0	0.000	0.00	0.00	25
TOTALS:	5299.0	86290	1.087	4.00	3.68	

NUMBER OF CUSTOMERS FOR THE PERIOD = 79386 % ASA = 99.999

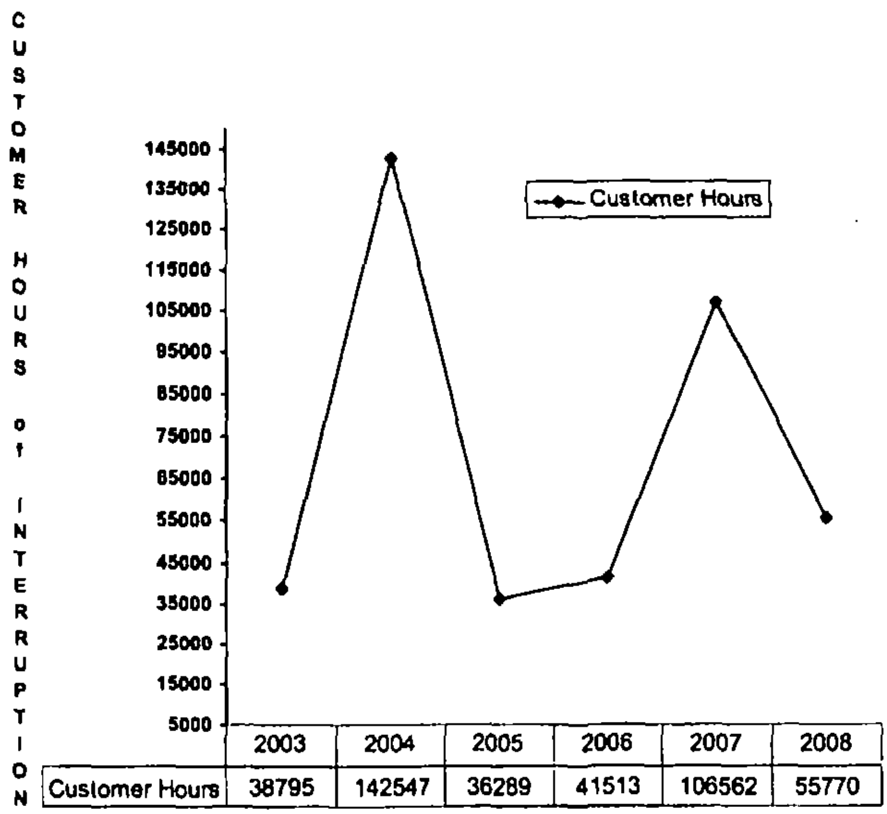
SAIF = SYSTEM AVERAGE INTERRUPTION FREQUENCY

SAID = SYSTEM AVERAGE INTERRUPTION DURATION (MINUTES)

CAID = CUSTOMER AVERAGE INTERRUPTION DURATION

THE OUTAGE CAUSES ARE LISTED IN ORDER OF ITS SAIF

2003-2008
INTERRUPTIONS CAUSED BY TREES & BRANCHES
Not-Normalized



	2003	2004	2005	2006	2007	2008
Customer Hours	38795	142547	36289	41513	106562	55770

YEAR

APPENDIX E
HELCO vs NON-HELCO GENERATION
2003-2008 Service Reliability Indices
Not-Normalized

HELCO Generation

Year	ASA	Number of Customers	Customer Interruptions	CID	SAIF	CAID
2003	99.997	67,879	37,662	15,637	0.555	13.82
2004	99.996	70,124	89,233	20,662	1.273	13.89
2005	99.997	72,513	69,509	14,314	0.959	12.36
2006	99.995	75,353	105,589	26,467	1.401	15.04
2007	99.999	77,933	28,246	3,349	0.362	7.11
2008	99.999	79,386	66,538	3,709	0.838	3.34

Non-HELCO Generation

Year	ASA	Number of Customers	Customer Interruptions	CID	SAIF	CAID
2003	99.996	67,879	73,007	22,115	1.076	18.17
2004	99.992	70,124	141,437	45,719	2.017	19.39
2005	99.998	72,513	36,956	6,577	0.51	10.68
2006	99.998	75,353	60,262	10,243	0.8	10.20
2007	*99.998*	*77,933*	*64,217*	*7,869*	*0.824*	*7.35*
2008	99.999	79,386	19,752	1,590	0.249	4.83

2008
HELCO GENERATION SERVICE RELIABILITY SUMMARY
Not-Normalized

Cause of Outage	CUST-HR	CUST-INT	SAIF	SAID	CAID	SAID RANK
Faulty Equip Opn	3708.6	66538	0.838	2.80	3.34	1
Man or Animal	0.0	0	0.000	0.00	0.00	17
Tsf Overload	0.0	0	0.000	0.00	0.00	2
Equip Failure	0.0	0	0.000	0.00	0.00	3
Balloon/Kite	0.0	0	0.000	0.00	0.00	4
Other Persnl Err	0.0	0	0.000	0.00	0.00	5
Unknown	0.0	0	0.000	0.00	0.00	6
Customer Maint	0.0	0	0.000	0.00	0.00	7
Sys Add/Removal	0.0	0	0.000	0.00	0.00	8
Forced Maint	0.0	0	0.000	0.00	0.00	9
Scheduled Maint	0.0	0	0.000	0.00	0.00	10
Balance Load	0.0	0	0.000	0.00	0.00	11
Transfer Load	0.0	0	0.000	0.00	0.00	12
Flood / Tsunami	0.0	0	0.000	0.00	0.00	13
Customer Equip	0.0	0	0.000	0.00	0.00	14
Deterioration	0.0	0	0.000	0.00	0.00	23
Auto Accident	0.0	0	0.000	0.00	0.00	30
Tsf Failure	0.0	0	0.000	0.00	0.00	29
Cable Fault	0.0	0	0.000	0.00	0.00	28
Flashover	0.0	0	0.000	0.00	0.00	27
Loose Connection	0.0	0	0.000	0.00	0.00	26
Opn or Sw Error	0.0	0	0.000	0.00	0.00	15
Equip Overload	0.0	0	0.000	0.00	0.00	24
Lightning	0.0	0	0.000	0.00	0.00	16
Vandalism	0.0	0	0.000	0.00	0.00	22
Excavate Constr	0.0	0	0.000	0.00	0.00	21
Equip Contact	0.0	0	0.000	0.00	0.00	20
Fire	0.0	0	0.000	0.00	0.00	19
Foreign Objects	0.0	0	0.000	0.00	0.00	18
Tree or Branches	0.0	0	0.000	0.00	0.00	31
High Wind	0.0	0	0.000	0.00	0.00	25
TOTALS:	3708.6	66538	0.838	2.80	3.34	

NUMBER OF CUSTOMERS FOR THE PERIOD = 79386 % ASA = 99.999

SAIF = SYSTEM AVERAGE INTERRUPTION FREQUENCY

SAID = SYSTEM AVERAGE INTERRUPTION DURATION (MINUTES)

CAID = CUSTOMER AVERAGE INTERRUPTION DURATION

THE OUTAGE CAUSES ARE LISTED IN ORDER OF ITS SAIF

2008
Non-HELCO GENERATION SERVICE RELIABILITY SUMMARY
Not-Normalized

Cause of Outage	CUST-HR	CUST-INT	SAIF	SAID	CAID	SAID RANK
Customer Equip	1590.4	19752	0.249	1.20	4.83	1
Man or Animal	0.0	0	0.000	0.00	0.00	17
Tsf Overload	0.0	0	0.000	0.00	0.00	2
Balloon/Kite	0.0	0	0.000	0.00	0.00	3
Other Persnl Err	0.0	0	0.000	0.00	0.00	4
Unknown	0.0	0	0.000	0.00	0.00	5
Customer Maint	0.0	0	0.000	0.00	0.00	6
Sys Add/Removal	0.0	0	0.000	0.00	0.00	7
Forced Maint	0.0	0	0.000	0.00	0.00	8
Scheduled Maint	0.0	0	0.000	0.00	0.00	9
Balance Load	0.0	0	0.000	0.00	0.00	10
Transfer Load	0.0	0	0.000	0.00	0.00	11
Flood / Tsunami	0.0	0	0.000	0.00	0.00	12
Opn or Sw Error	0.0	0	0.000	0.00	0.00	13
Faulty Equip Opn	0.0	0	0.000	0.00	0.00	14
Deterioration	0.0	0	0.000	0.00	0.00	23
Auto Accident	0.0	0	0.000	0.00	0.00	30
Tsf Failure	0.0	0	0.000	0.00	0.00	29
Cable Fault	0.0	0	0.000	0.00	0.00	28
Flashover	0.0	0	0.000	0.00	0.00	27
Loose Connection	0.0	0	0.000	0.00	0.00	26
Vandalism	0.0	0	0.000	0.00	0.00	15
Equip Overload	0.0	0	0.000	0.00	0.00	24
Lightning	0.0	0	0.000	0.00	0.00	16
Equip Failure	0.0	0	0.000	0.00	0.00	22
Excavate Constr	0.0	0	0.000	0.00	0.00	21
Equip Contact	0.0	0	0.000	0.00	0.00	20
Fire	0.0	0	0.000	0.00	0.00	19
Foreign Objects	0.0	0	0.000	0.00	0.00	18
Tree or Branches	0.0	0	0.000	0.00	0.00	31
High Wind	0.0	0	0.000	0.00	0.00	25
TOTALS:	1590.4	19752	0.249	1.20	4.83	

NUMBER OF CUSTOMERS FOR THE PERIOD = 79386 % ASA = 99.999

SAIF = SYSTEM AVERAGE INTERRUPTION FREQUENCY

SAID = SYSTEM AVERAGE INTERRUPTION DURATION (MINUTES)

CAID = CUSTOMER AVERAGE INTERRUPTION DURATION

THE OUTAGE CAUSES ARE LISTED IN ORDER OF ITS SAIF

EXHIBIT 8

Maui Electric Company, Ltd. • 210 West Kamehameha Avenue • PO Box 398 • Kahului, Maui, HI 96733-6898 • (808) 871-8461

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2009 MAY -7 P 4:00
PUBLIC UTILITIES COMMISSION

Edward L. Reinhardt
President

May 7, 2009

The Honorable Chairman and Members of the
Hawaii Public Utilities Commission
Kekuanaoa Building
465 South King Street, First Floor
Honolulu, Hawaii 96813

Dear Commissioners:

Subject: MECO 2008 Annual Service Reliability Report

Maui Electric Company, Limited respectfully submits a copy of its 2008 Annual Service Reliability Report.

Sincerely,

Edward L. Reinhardt

Attachment

c: Division of Consumer Advocacy (with Attachment)

EXHIBIT 8

ANNUAL SERVICE RELIABILITY REPORT

2008

MAUI ELECTRIC COMPANY, LIMITED

MAUI ELECTRIC COMPANY, LIMITED

ANNUAL SERVICE RELIABILITY REPORT

2008

Prepared By
Transmission and Distribution Department
Operations Division

INTRODUCTION

This is the 2008 service reliability report for Maui Electric Company, Limited (MECO). The average number of electric customers increased from 65,728 in 2007 to 66,810 in 2008 (an increase of 1.65%). The peak 2008 demand for the system was 199.0 MW (gross) that occurred on January 9, 2008. The peak 2008 demand was lower than the 2007 peak demand of 209.3 MW (gross) on November 7, 2007 (a decrease of 4.92%).

The system interruption summary for the past year and the system reliability indices for the five prior years are presented to depict the quality of service to the electrical energy consumer.

The definitions of terms, the explanation and equations of reliability indices are contained on Attachments B-1 through B-3.

The Average Service Availability Index (ASA), the System Average Interruption Frequency Index (SAIF), the Customer Average Interruption Duration Index (CAID), and the System Average Interruption Duration Index (SAID) are indicators of service reliability. These indices measure reliability in terms of the overall availability of electrical service (ASA), the frequency or number of times MECO's customers experience an outage during the year (SAIF), and the average length of time an interrupted customer is out of power (CAID). SAID is an indication of overall system reliability because it is the product of SAIF and CAID and incorporates the impact of frequency and duration of outages on MECO's total customer base (in this case, 66,810 customers).

ANALYSIS

This analysis of the system reliability for MECO is for the year 2008. To determine the relative level of reliability, the statistics for five prior years, 2003 through 2007, are used for comparison.

The reliability indices are calculated using the data from all sustained[1] system outages, except customer maintenance outages. MECO had not normalized the data for the 2003 and 2005 reliability indices. The 2004 reliability indices for MECO were normalized to exclude the effects of the January 14th Kona Storm. The 2006 reliability indices for MECO were normalized to exclude the effects of the October 15th earthquake. The 2007 reliability indices for MECO were normalized to exclude the effects of the January 29th and the December 5th Kona Storms. The 2008 reliability indices for MECO were normalized to exclude the effects of various catastrophic equipment failures and storms on *Maui, Molokai and Lanai.*

The data used in calculating the reliability indices was normalized in accordance with the guidelines specified in the report on reliability that was prepared for the Public Utilities Commission, titled "Methodology for Determining Reliability Indices for HECO Utilities," dated December 1990. That report indicates that normalization is allowed for "abnormal" situations such as hurricanes, tsunamis, earthquakes, floods, catastrophic equipment failures, and a single outage that cascades into a loss of load that is greater than 10% of the system peak load. These normalizations are made in calculating the reliability indices, because good engineering design takes into account safety, reliability, utility industry standards, and economics, and cannot always plan for catastrophic events.

Graphs of the ASA (Figure 1), SAIF (Figure 2), CAID (Figure 3), and SAID (Figure 4) for the six years are included.

[1] An interruption of electrical service of 1 minute or longer

2008 NORMALIZED RESULTS

The 2008 service reliability results were normalized to exclude the effects of various catastrophic equipment failures and large storms on Maui, Molokai and Lanai. There were 36 outages in 2008 that were classified as "abnormal" situations (i.e. catastrophic equipment failures and major storms) that cascaded into a loss of load greater than 10% of the system peak load.

The 2008 service reliability results (normalized) indicate that MECO made improvements in the ASA, SAIF, CAID and SAID indices compared to 2007.

- The ASA index of 99.9805% is an improvement from 2007 and is ranked the third best ASA index of the last six years. (Higher is better.)
- The SAIF index of 1.134 is an improvement from 2007 and is ranked the second best SAIF index of the last six years. (Lower is better.)
- The CAID index of 90.28 minutes is an increase from 2007 and is ranked the worst CAID index of the last six years. (Lower is better.)
- The SAID index of 102.38 minutes is an improvement from 2007 and is ranked the third best SAID index of the last six years. (Lower is better.)

Cable faults were the leading cause of outages in 2008, with 108 outages, which accounted for 20.26% of all outages. This was a decrease of 6.1% from 2007. Outages caused by trees or branches in lines were the second leading cause of outages in 2008, with 83 outages and accounted for 15.57% of all outages. This was a decreased of 6.7% from 2007.

MECO experienced 29 load shed events in 2008. Maui experienced 5 load shed events, Molokai experienced 12 load shed events and Lanai experienced 12 load shed events in 2008.

Annual Service Reliability Indices

The normalized results for 2008, the previous un-normalized indices for 2003 and 2005 and the normalized indices for 2004, 2006 and 2007 are shown in the table "Annual Service Reliability Indices". Figures 1 through 4 contain the same data shown in graphical form as well as the 2008 outages listed by cause and associated reliability indices shown on Attachments A1 and A2, (normalized results).

MECO
Table of Annual Service Reliability Indices

SYSTEM TOTALS	2003	2004 *	2005	2006 *	2007 *	2008 *
Number of Customers	60,651	61,846	63,103	64,405	65,728	66,810
Customer Hrs. Interrupted	48,567	77,122	126,010	235,186	186,022	114,001
Customer-Interruptions	45,446	99,424	162,827	249,485	170,299	75,764
ASA (Percent)	99.9909	99.9858	99.9772	99.9583	99.9692	99.9805
SAIF (Occurrence)	0.749	1.608	2.580	3.874	2.593	1.134
CAID (Minutes)	64.12	46.54	46.43	56.56	62.52	90.28
SAID (Minutes)	48.05	74.82	119.81	219.10	162.13	102.38

* Data normalized per guidelines specified in the report on reliability that was prepared for the Public Utilities Commission, titled "Methodology for Determining Reliability Indices for HECO Utilities," dated December 1990

FIGURE 1

MECO AVERAGE SERVICE AVAILABILITY
(ASA)

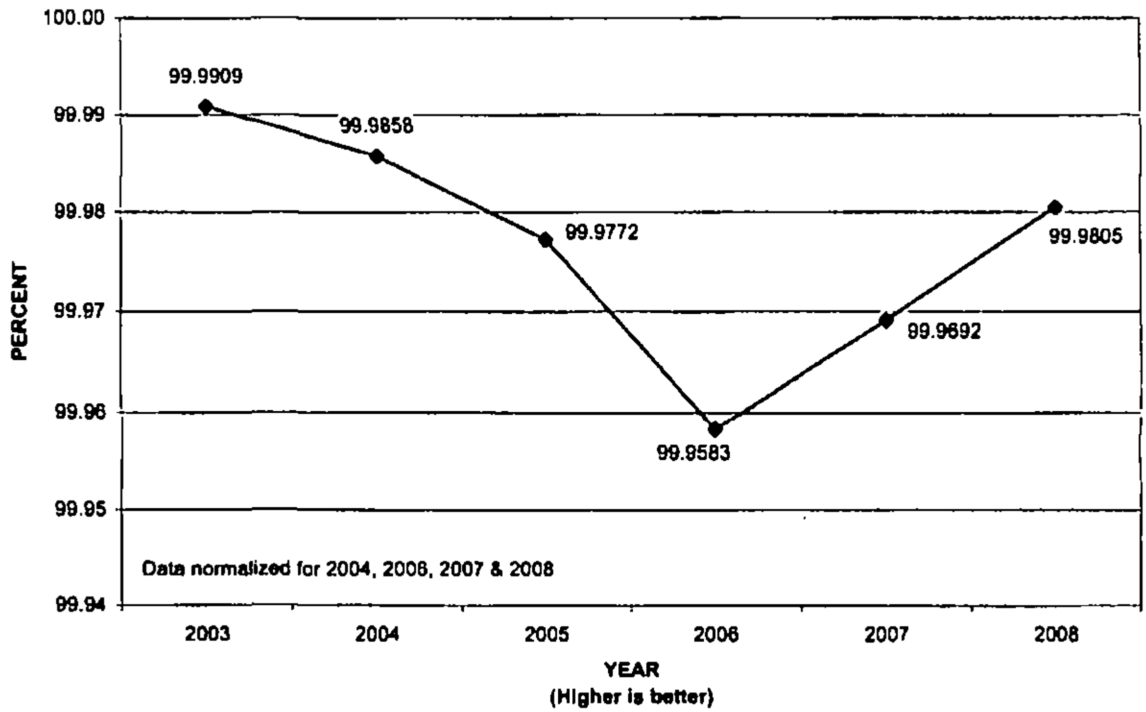
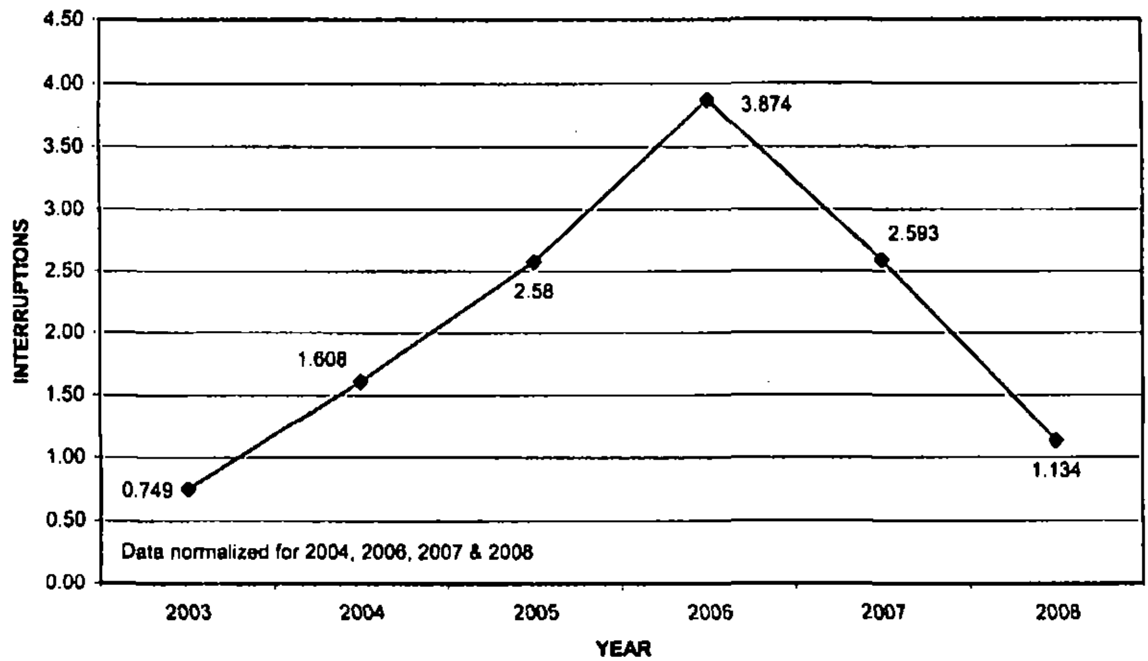


Figure 1 shows that the 2008 Average Service Availability (ASA) index has increased from the 2007 results of 99.9692% to 99.9805% during 2008. This was an increase of approximately 0.0113% in the 2008 Average Service Availability compared to the previous year. The 2008 service reliability results (normalized) showed that MECO made improvements in the SAIF and SAID indices compared to 2007, while the CAID index had increased compared to 2007.

FIGURE 2

**MECO SYSTEM AVERAGE INTERRUPTION FREQUENCY
SAIF**



(Lower is Better)

Figure 2 shows the System Average Interruption Frequency (SAIF) indices for the past six years. It shows that in 2008, the recorded SAIF index was 1.134 and it had decreased from 2007 by 52.3%.

A decrease in interruptions due to auto accidents, equipment failures and deterioration or corrosion contributed to a lower SAIF for 2008.

FIGURE 3

MECO CUSTOMER AVERAGE INTERRUPTION DURATION
(CAID)

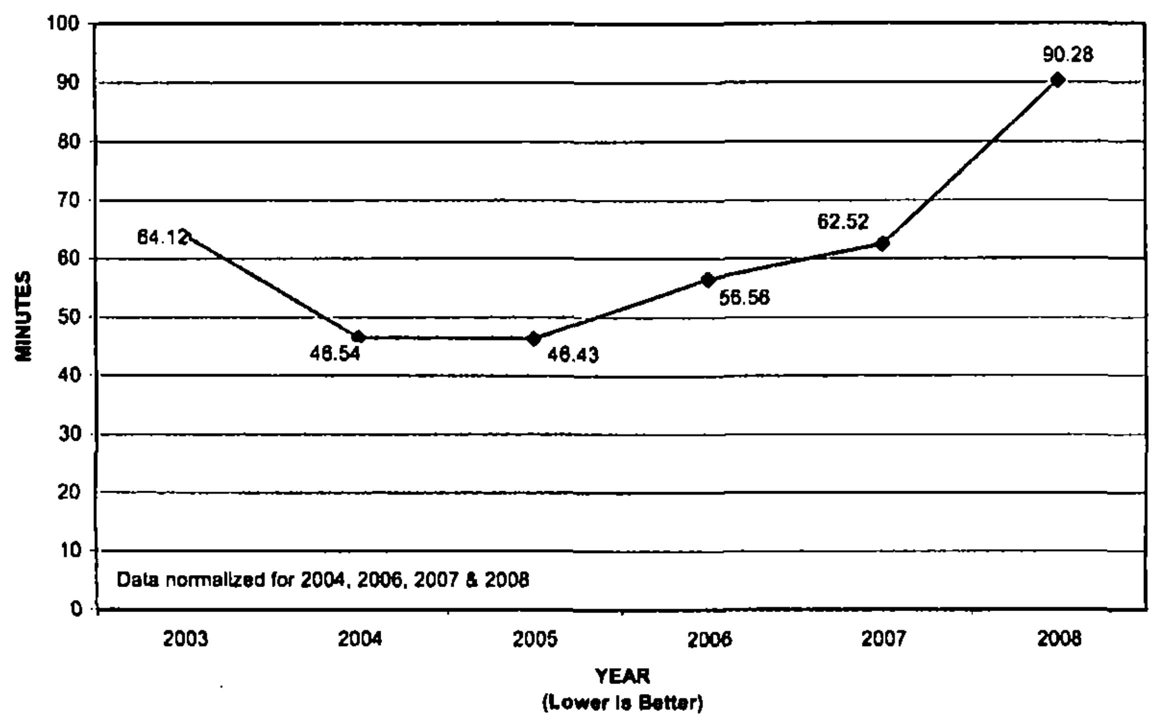


Figure 3 shows the Customer Average Interruption Duration (CAID) indices for the past six years.

The average electrical outage duration of 90.28 minutes per customer for 2008 is an increase of 44.4% from the previous year.

The contributing factors to the increase of the CAID index are outages related to high winds and trees or branches in lines. Outages due to high winds increased in 2008, which incurred 26,709.1 customer interruption hours and accounted for 23.4% of all customer interruption hours in 2008. Outages due to trees or branches in lines also increased in 2008, which incurred 26,804.1 customer interruption hours and accounted for 23.5% of all customer interruption hours in 2008. Outages related to high winds and trees or branches in lines for 2008 caused extensive damage to MECO property and required time consuming work (i.e. the replacement of poles and conductors), which increases the duration of the outage. Also, a majority of the outages caused by trees or branches in lines occurred in rural areas, which increased the duration of the outage due to the additional travel time required to reach the various outage sites.

FIGURE 4

MECO SYSTEM AVERAGE INTERRUPTION DURATION
(SAID)

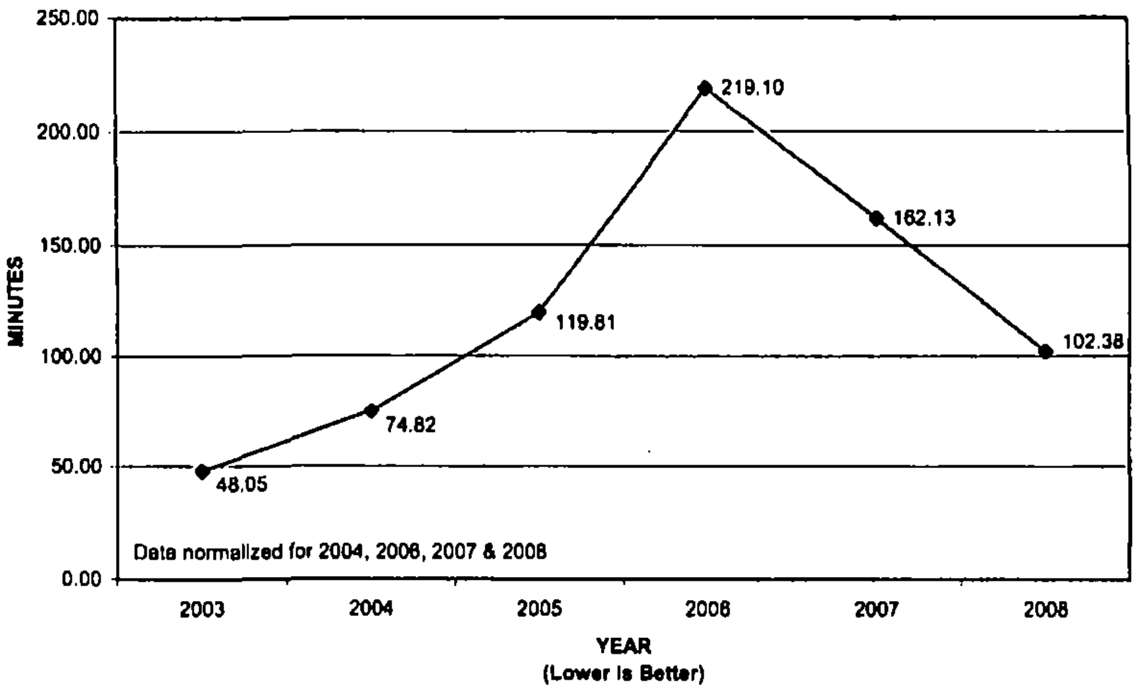


Figure 4 shows the System Average Interruption Duration (SAID) indices for the past six years. It shows that in 2008, the recorded SAID index was 102.38 and it had decreased from 2007 by 36.9%.

The SAID is the composite of both the SAIF and CAID indices and produces a broader benchmark of system reliability by combining both the duration and the number of customer interruptions during a given period of time. The lower SAID result was due to a decrease in the SAIF statistics as noted previously.

Maui Electric Company System Interruption
Service Reliability - System Total
From: January 1, 2008 To: December 31, 2008

Cause	Cust-Hr	Cust-Int	SAIF	SAID	CAID	SAID Rank
07. Trees or branches in lines	26804.1	15123.0	0.226	24.07	106.34	1
10. High wind	26709.1	11178.0	0.167	23.99	143.37	2
12. Flashover	7718.7	8808.0	0.132	6.93	52.58	6
29. Unknown failure	8075.4	7600.0	0.114	7.25	63.75	5
08. Deterioration, rot, corrosion, termites	11939.7	5568.0	0.083	10.72	128.66	3
26. Maintenance - forced	1748.2	4990.0	0.075	1.57	21.02	9
13. Cable fault	7243.2	4921.0	0.074	6.50	88.31	7
17. Equipment failure	6154.5	4868.0	0.073	5.53	75.86	8
01. Automobile Accident	9173.8	3408.0	0.051	8.24	161.51	4
21. Failure of customer's electrical equipment	401.8	2514.0	0.038	0.36	9.59	18
03. Foreign objects in lines or equipment	1628.0	2137.0	0.032	1.46	45.71	10
20. Operator or switching error	283.3	1196.0	0.018	0.25	14.21	19
16. Equipment overload	1114.3	882.0	0.013	1.00	75.80	12
11. Loose connection	660.8	742.0	0.011	0.59	53.43	15
25. Maintenance - scheduled	1220.1	706.0	0.011	1.10	103.69	11
31. Mylar Balloon	469.3	390.0	0.006	0.42	72.20	17
14. Transformer failure other than overload	826.3	168.0	0.003	0.74	295.10	13
05. Contact by moving equipment	235.7	113.0	0.002	0.21	125.14	21
24. Nec. Int. to balance load or system conv.	8.1	98.0	0.001	0.01	4.97	25
09. Lightning	705.6	77.0	0.001	0.63	549.78	14
19. Faulty operation of equipment	22.8	75.0	0.001	0.02	18.27	24
02. Man or animals in lines or equipment	498.3	63.0	0.001	0.45	474.60	16
06. Excavation and construction	37.2	50.0	0.001	0.03	44.60	23
15. Transformer overload	53.7	45.0	0.001	0.05	71.62	22
27. System additions or removals	268.7	44.0	0.001	0.24	366.45	20
30. Other company personnel error	0.0	0.0	0.000	0.00	0.00	28
23. Nec. Int. to transfer load (out of phase)	0.0	0.0	0.000	0.00	0.00	27
22. Tsunami, earthquake, or flooding	0.0	0.0	0.000	0.00	0.00	30
18. Vandalism	0.0	0.0	0.000	0.00	0.00	29
04. Fire	0.0	0.0	0.000	0.00	0.00	26
Total	114000.8	75764.0	1.134	102.38	90.28	

Number of Customers for the Period 66810
SAIF = System Average Interruption Frequency
SAID = System Average Interruption Duration
CAID = Customer Average Interruption Duration
The Outage Causes are Listed in Order of its SAIF Index

Maui Electric Company System Interruption

System Total

From: January 1, 2008 To: December 31, 2008

Cause	Interruptions Number	Interruptions % Of Total	Customer Hours Hours	Customer Hours % Of Total
Non-Connected System Emergency	116	21.76%	39248.2	34.4%
Foreign Objects	5	0.94%	1628.0	1.4%
Contact by Moving Equipment	3	0.56%	235.7	0.2%
Excavation and Construction	2	0.38%	37.2	0.0%
Fire	0	0.00%	0.0	0.0%
Auto Accident	14	2.63%	9173.8	8.0%
Man or Animal in Lines or Equipment	3	0.56%	498.3	0.4%
Trees or Branches	83	15.57%	26804.1	23.5%
Vandalism	0	0.00%	0.0	0.0%
Customer Equipment Failure Affecting Company	4	0.75%	401.8	0.4%
Mylar Balloons	2	0.38%	469.3	0.4%
Error	4	0.75%	283.3	0.2%
Operator or Switching	4	0.75%	283.3	0.2%
Other Company Personnel	0	0.00%	0.0	0.0%
Weather	27	5.07%	27414.7	24.0%
Lightning	15	2.81%	705.6	0.6%
High Wind	12	2.25%	26709.1	23.4%
Tsunami, Earthquake or Flooding	0	0.00%	0.0	0.0%
Non-Transformer Equipment	215	40.34%	34854.0	30.6%
Loose connection	5	0.94%	660.8	0.6%
Flashover	9	1.69%	7718.7	6.8%
Equipment	16	3.00%	6154.5	5.4%
Cable Fault	108	20.26%	7243.2	6.4%
Equipment Overload	11	2.06%	1114.3	1.0%
Deterioration, Rot, Corrosion or Termites	63	11.82%	11939.7	10.5%
Faulty Operation of Equipment	3	0.56%	22.8	0.0%
Transformer	28	5.25%	880.0	0.8%
Transformer	5	0.94%	53.7	0.0%
Transformer Failure Other Than Overload	23	4.32%	826.3	0.7%
Switching	4	0.75%	8.1	0.0%
NEC Int to Transfer Load (Out of Phase)	0	0.00%	0.0	0.0%
NEC Int to Balance Load or Conversion	4	0.75%	8.1	0.0%
Unknown After Tests and Inspections	50	9.38%	8075.4	7.1%
Maintenance	80	15.01%	2968.3	2.6%
Scheduled	65	12.20%	1220.1	1.1%
Forced	15	2.81%	1748.2	1.5%
System Additions or Removals	9	1.69%	268.7	0.2%
TOTALS	533		114000.8	

DEFINITION OF TERMS

OUTAGE

The state of a component when it is not available to perform its intended function due to some event directly associated with that component. An outage may or may not cause an interruption of service to consumers depending on system configuration.

INTERRUPTION

The loss of service to one or more customers and is a result of one or more component outages.

INTERRUPTION DURATION

The period from the initiation of an interruption to a customer until service has been restored to that customer.

MOMENTARY INTERRUPTION

An interruption that has a duration limited to the period required to restore service by automatic or supervisory-controlled switching operations or by manual switching at locations where an operator is immediately available. Such switching operations must be completed in a specific time not to exceed one minute. Previous issues of this report indicated that a momentary interruption has a duration not to exceed five minutes. A December 1990 report, "Methodology for Determining Reliability Indices for HECO Utilities," indicated that momentary interruptions will have a duration less than one minute.

SUSTAINED INTERRUPTION

Any interruption not classified as a momentary interruption. Only this type of interruption is included in the reliability indices which follow: In conformance with the guidelines established in the report, "Methodology for Determining Reliability Indices for HECO Utilities," dated December 1990, a sustained interruption has a duration of one minute or longer.

CUSTOMER INTERRUPTION

One interruption of one customer.

NOTE: Interruption to customers at their request (e.g., customer maintenance) are not considered.

RELIABILITY INDICES

Reliability indices used in this report conform to standards proposed by both the Edison Electric Institute (EEI) and the Institute of Electrical and Electronics Engineers (IEEE) unless otherwise indicated in the above definitions. Four reliability indices that convey a meaningful representation of the level of reliability were selected and are presented in this report. These reliability indices are as follows:

AVERAGE SERVICE AVAILABILITY (ASA)

Total customer hours actually served as a percentage of total customer hours possible during the year. This indicates the extent to which electrical service was available to all customers. This index has been commonly referred to as the "Index of Reliability." A customer-hour is calculated by multiplying the number of customers by the number of hours in the period being analyzed.

$$ASA = \frac{\sum \text{No. of Customer Hours Actually Served during the year}}{\sum \text{No. of Customer Hours Possible during the year}} \times 100\%$$

SYSTEM AVERAGE INTERRUPTION FREQUENCY (SAIF)

The number of customer interruptions per customer served during the year. This index indicates the average number of sustained interruptions experienced by all customers serviced on the system.

$$SAIF = \frac{\sum \text{No. of Customer Interruptions Experienced during the year}}{\text{Average No. of Customers served during the year}}$$

CUSTOMER AVERAGE INTERRUPTION DURATION (CAID)

The interruption duration per customer interrupted during the year. This index indicates the average duration of an interruption for those customers affected by a sustained interruption.

$$CAID = \frac{\sum \text{Duration of Interruptions x No. of Customers affected}}{\sum \text{No. of Customer Interruptions Experienced for the year}}$$

SYSTEM AVERAGE INTERRUPTION DURATION (SAID)

The interruption duration per customer served during the year. This index indicates the average interruption time experienced by all customers serviced on the system.

$$SAID = \frac{\sum \text{Duration of Interruption x No. of Customers affected}}{\text{Average No. of Customers Served during the year}}$$

<u>CERTIFICATE OF SERVICE</u>

The undersigned hereby certifies that, on this date, a copy of the foregoing document was duly served by first-class postage prepaid mail and electronic mail to the following parties addressed as follows:

Dean Nishina Executive Director Dept. Of Commerce And Consumer Affairs Division Of Consumer Advocacy P. O. Box 541 Honolulu, HI 96809	2 copies via U.S. Mail Dean.K.Nishina@dcca.hawaii.gov

The undersigned hereby certifies that, on this date, a copy of the foregoing document was duly served by electronic mail to the following parties addressed as follows:

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